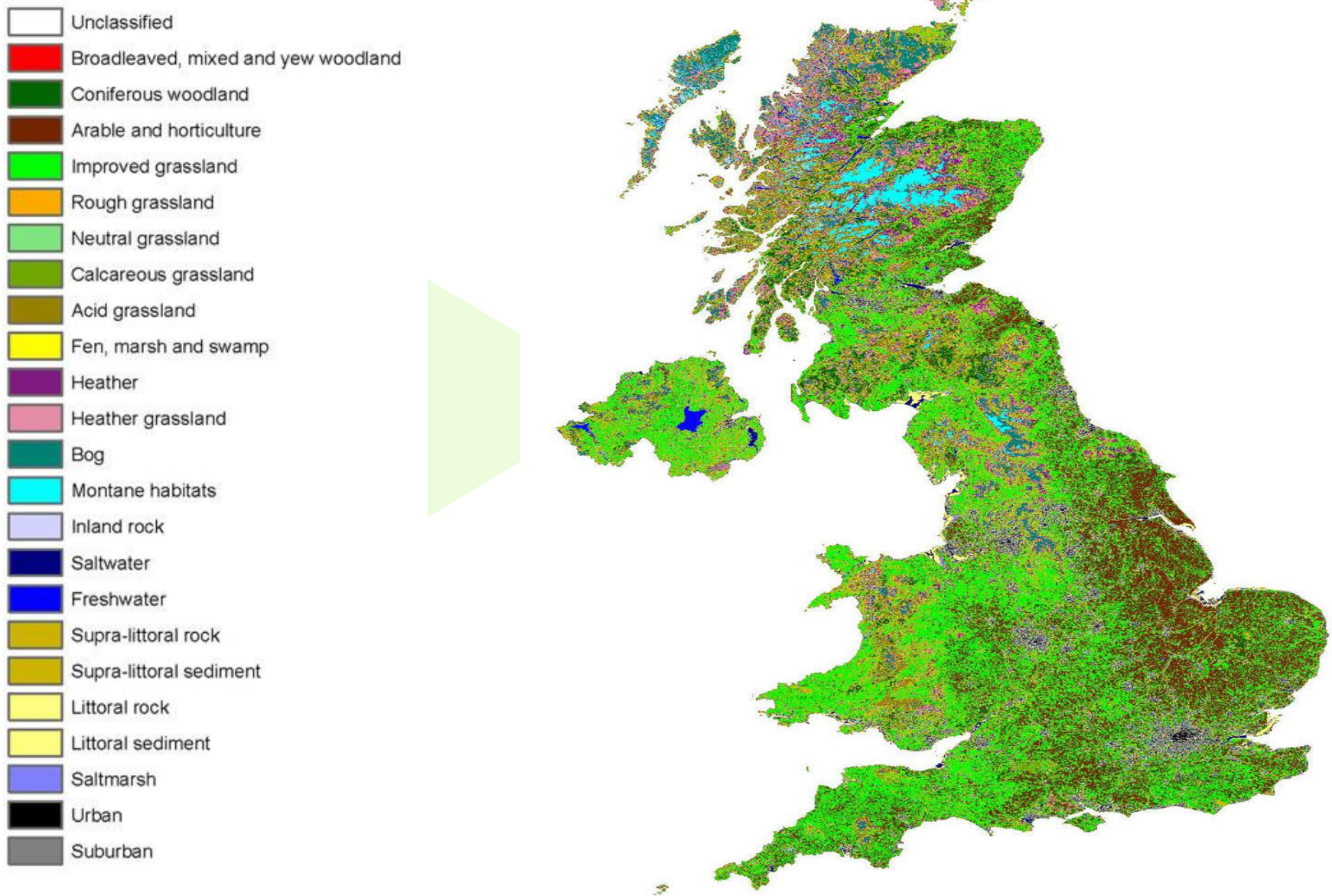
Malting Barley

Boortmalt Ireland visit to SRUC
December 5th 2013

Steve Hoad
steve.hoad@sruc.ac.uk

UK land map
(CEH Information Gateway)

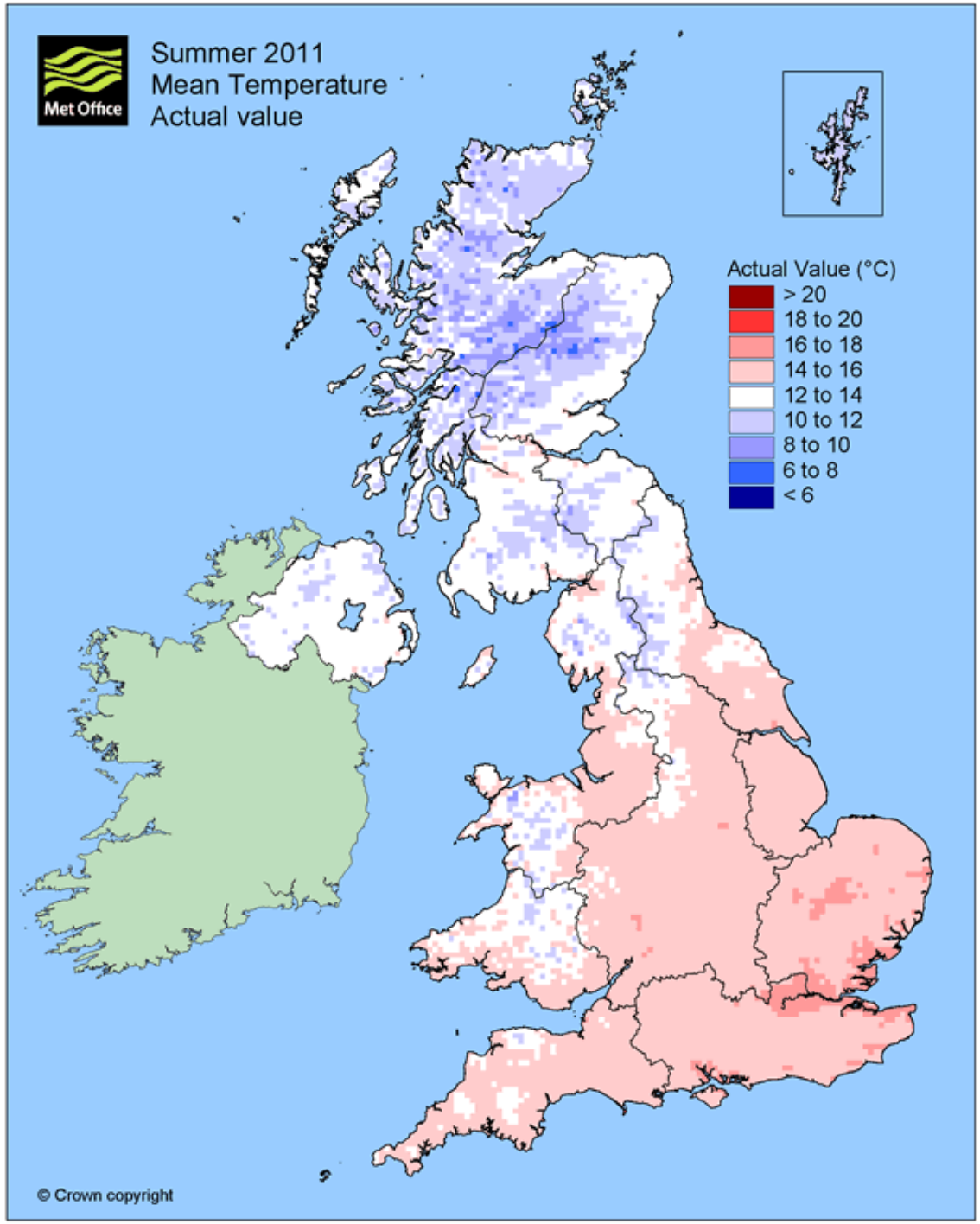
UK land area = 24.5 Mha



Summer temperature

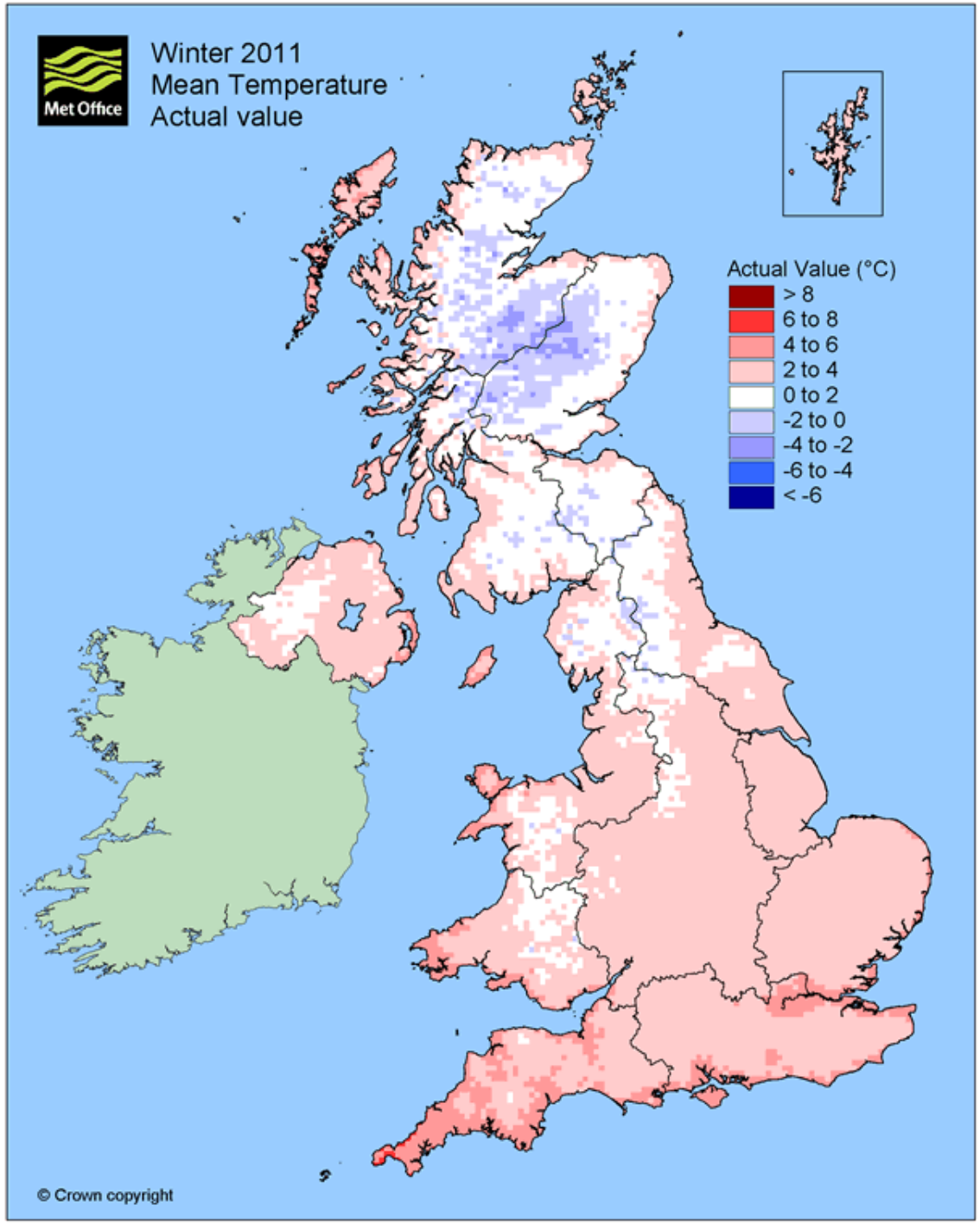
North-south gradient

Strong coastal and altitude influences



Winter temperature

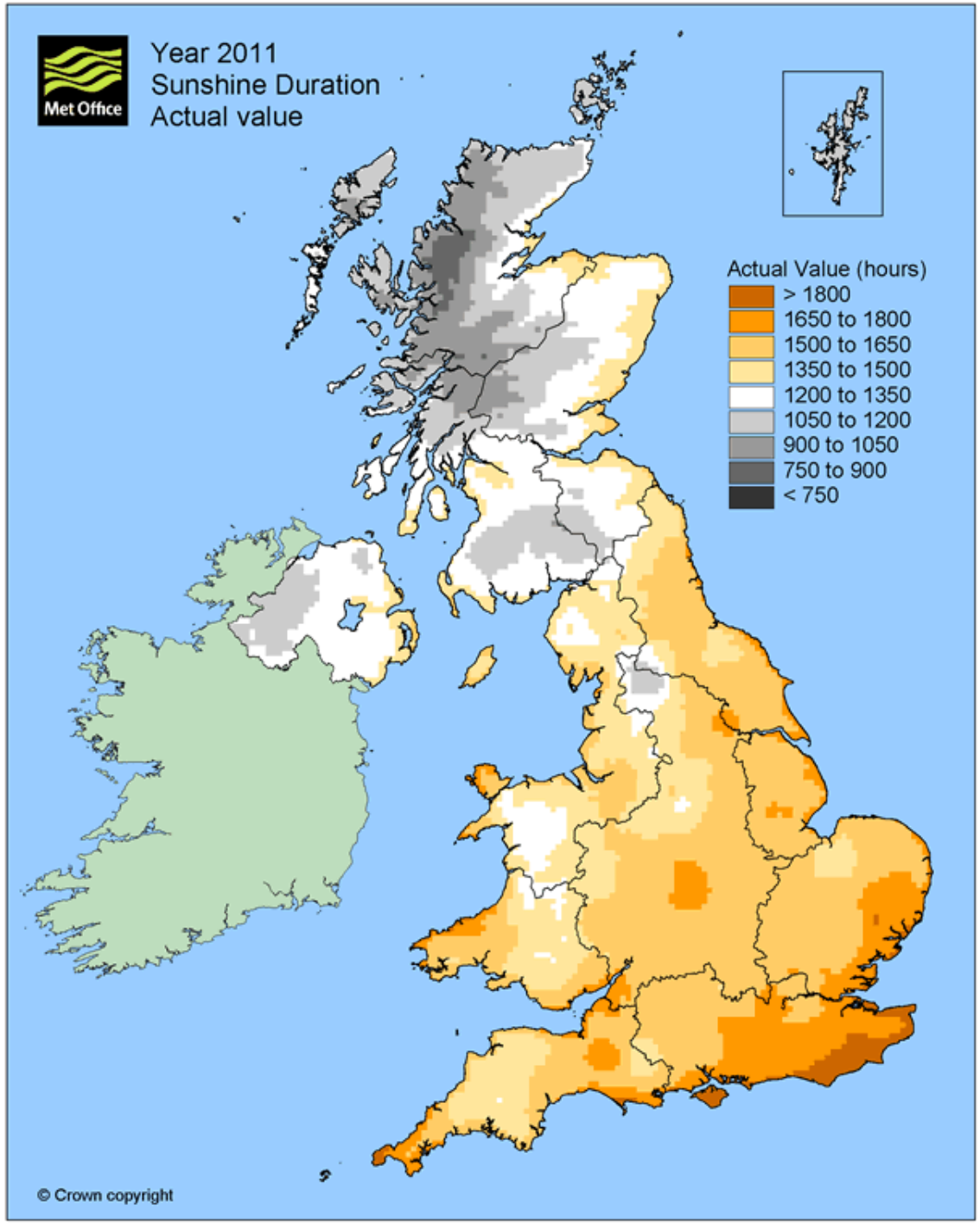
Coastal areas of Scotland can be relatively mild



Annual sunshine hours

Longer summer days in Scotland, but more cloud cover

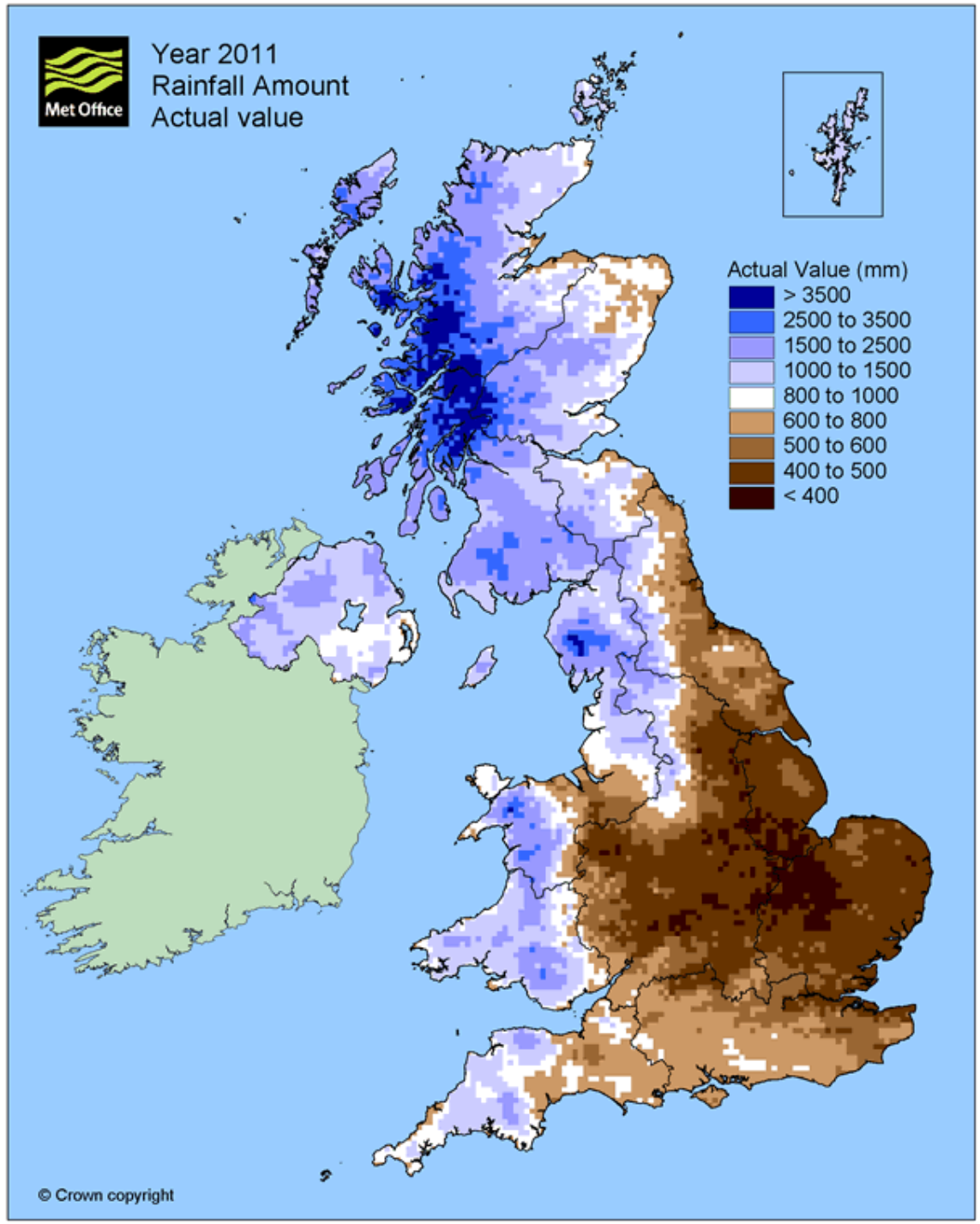
Strong east-west gradient in Scotland



Annual rainfall

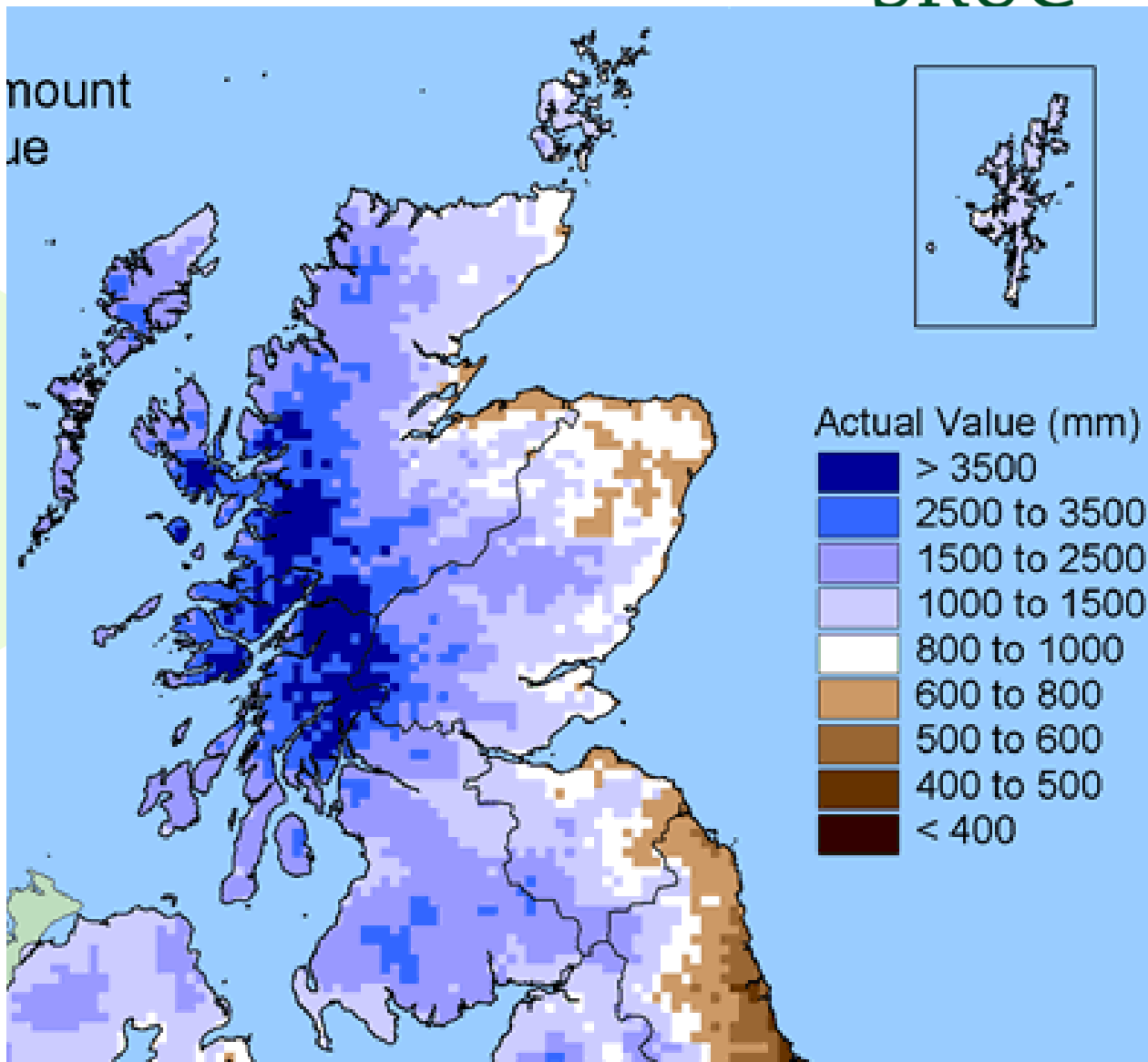
Very strong north-south and east-west variation

This has a large influence on the distribution of farm types and crops



Strong east–west gradient

Strong coastal and altitudinal influences



Agricultural land use in the UK

Main agricultural categories as millions of ha and percentage of total agricultural area

	UK Mha (% AA)	Scotland Mha (% AA)
Total land area	24.50	7.88
Agricultural Area	17.20	5.63
Arable crops	4.47 (26%)	0.63 (8%)
Mixed arable	1.72 (10%)	1.54 (20%)
Improved grassland	5.40 (31%)	1.41 (18%)
Rough grazing	5.30 (30%)	4.04 (51%)

Land Capability for Agriculture in Scotland

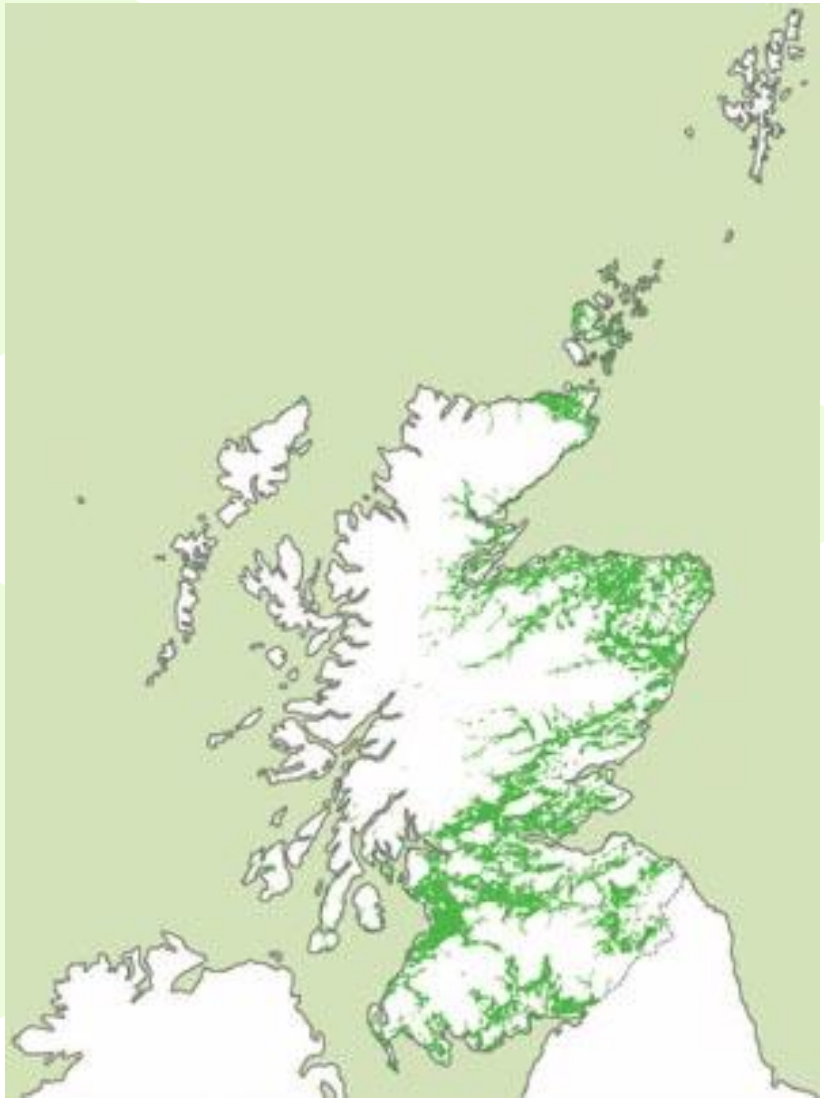
Arable

626,000 ha or 8% of total land

- Shallow slopes
- Soil > 45 cm depth
- Drainage good or imperfect
- Suitable for a wide range of crops

Source: 'Exploring Scotland' at JHI (previously The Macaulay Land Use Research Institute)

Land Capability for Agriculture in Scotland

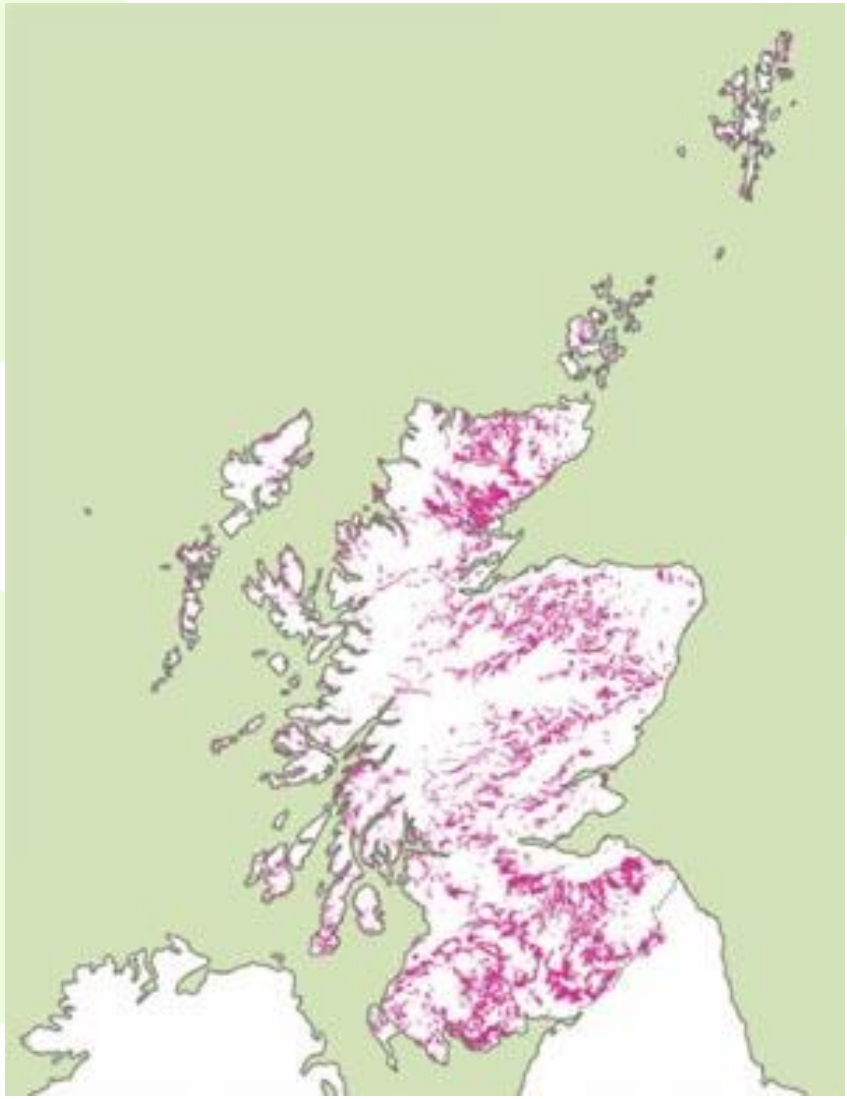


Mixed Agriculture

1,540,000 ha or 20% of total land

- Less gradual slopes
- Imperfect drainage
- Suitable for a moderate range of crops
- Some crops severely limited

Land Capability for Agriculture in Scotland



Improved grassland

1,406,000 ha or 18% of total land

- Climatic, slope and soil limitations
- Cultivations generally not possible
- Potential for limited improvement

Land Capability for Agriculture in Scotland

Rough grazing

4,036,000 ha or 51% of total land

- Very serve limitations: steep, poorly drained, cool, cold, wet, acidic soils
- Mechanical interventions not possible
- Range from high to low grassland value

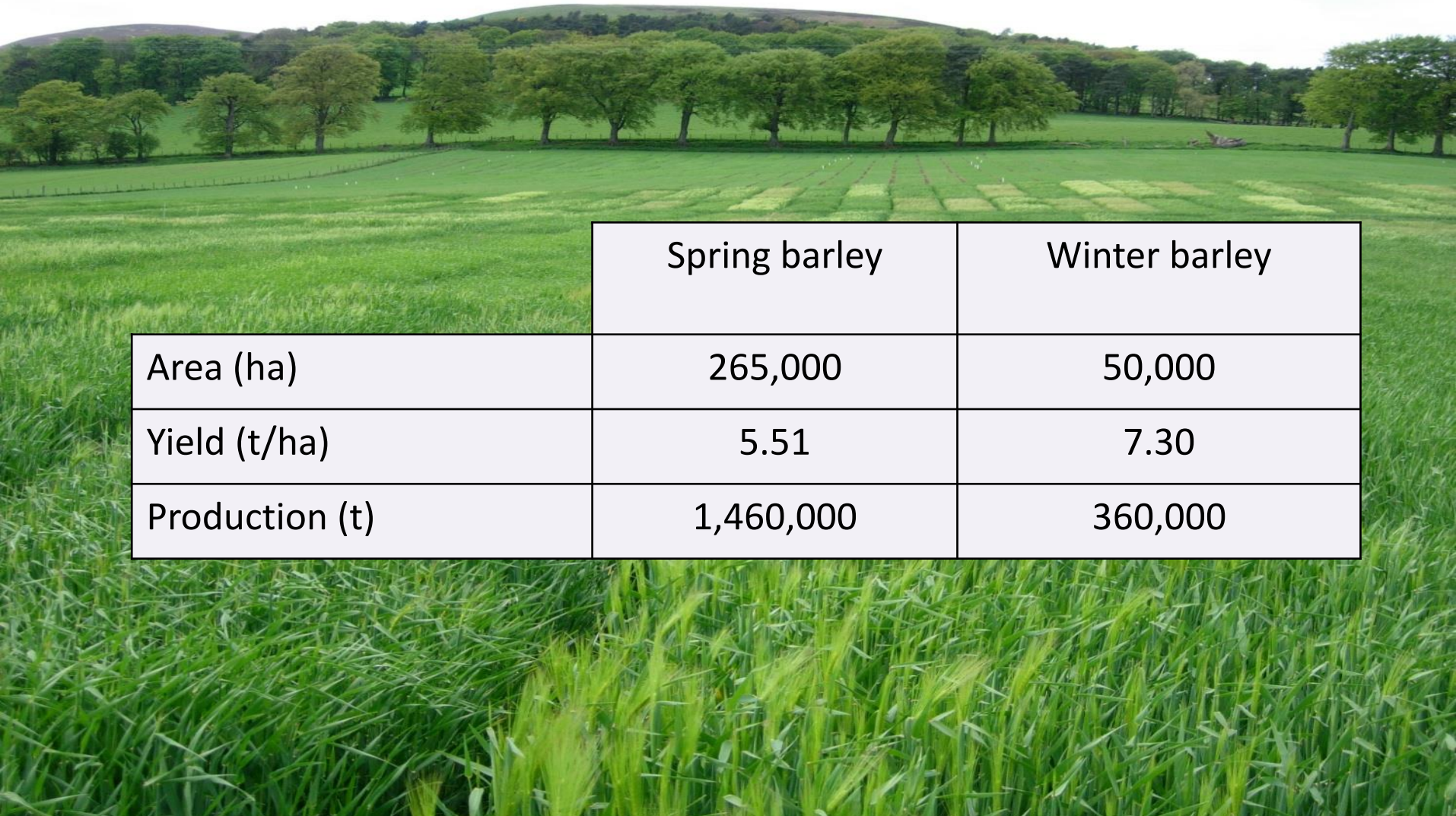
Main crops of the UK and Scotland

	UK (ha)	Scotland (ha)
Arable crops (exc fallow)	4,470,000	560,000
Cereals	3,000,000	450,000
Potatoes	150,000	31,000
Oilseeds	600,000	38,000
Legumes	220,000	5,000
Sugar beet	120,000	---
Vegetables	120,000	15,000
Soft fruit	10,000	1,800

Cereal crops of the UK and Scotland

	UK (ha)	Scotland (ha)
Winter wheat	1,900,000	110,000
Spring wheat	19,000	1,000
Winter barley	490,000	50,000
Spring barley	500,000	260,000
Winter oats	40,000	7,000
Spring oats	60,000	16,000
Other cereals	20,000	1,000

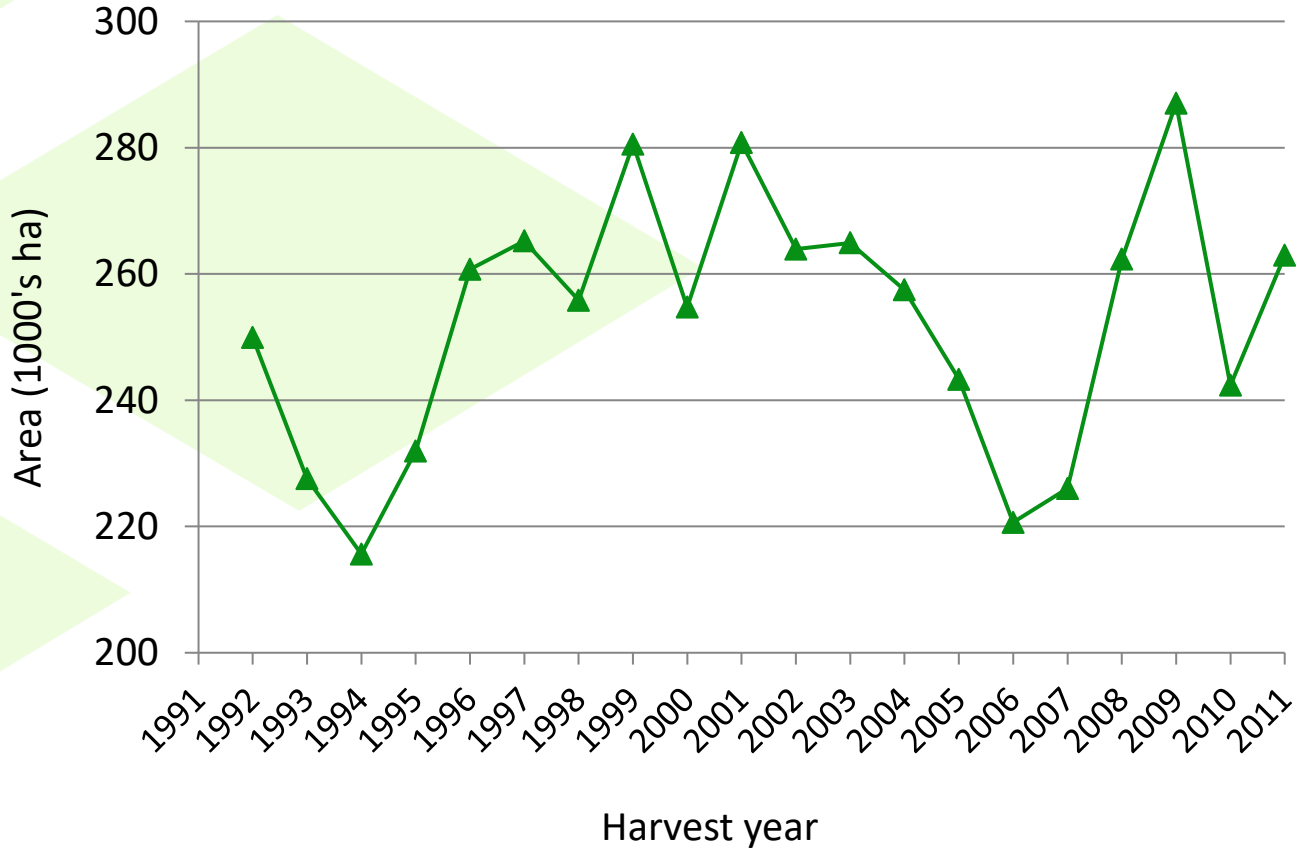
Scottish barley crop



	Spring barley	Winter barley
Area (ha)	265,000	50,000
Yield (t/ha)	5.51	7.30
Production (t)	1,460,000	360,000

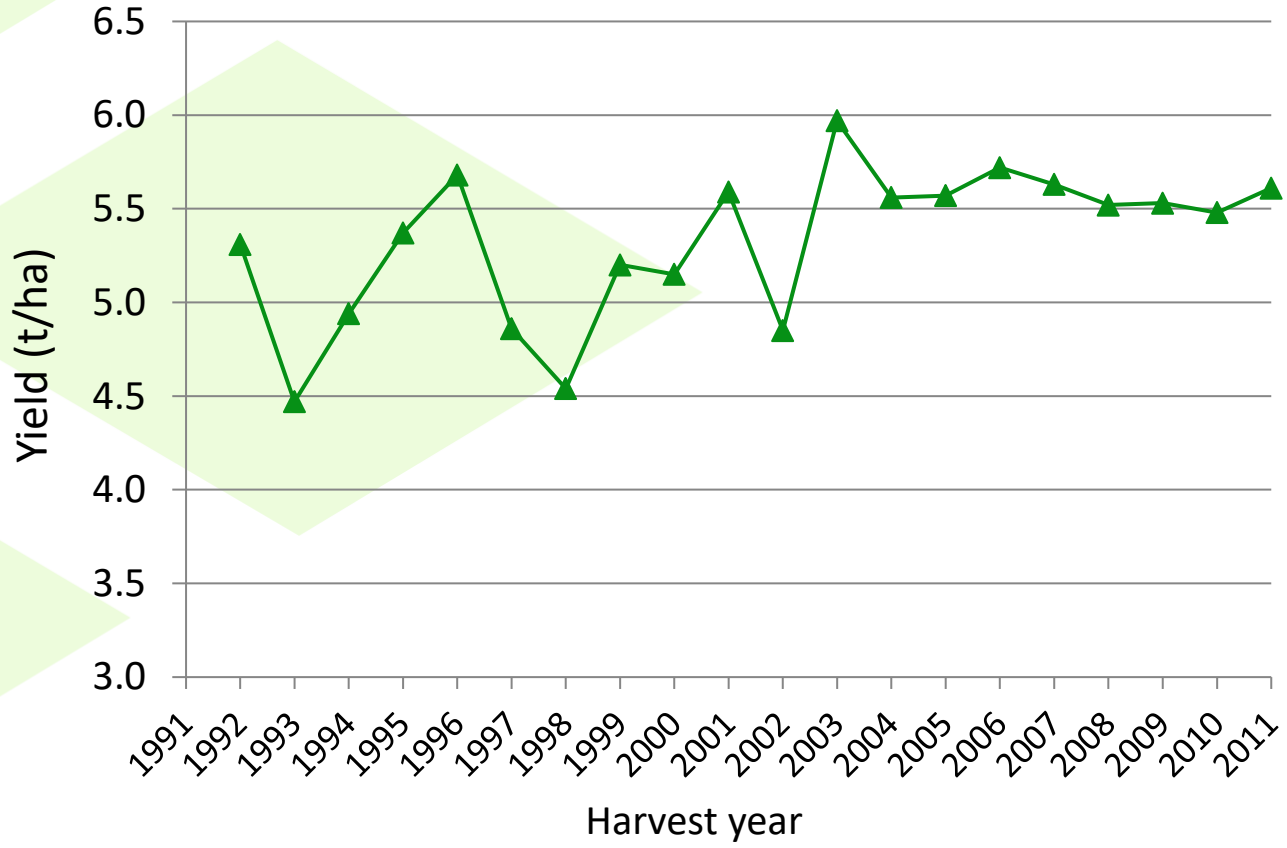
Scottish spring barley: Area

Area is influenced by winter crop sowings and price or demand of malting barley



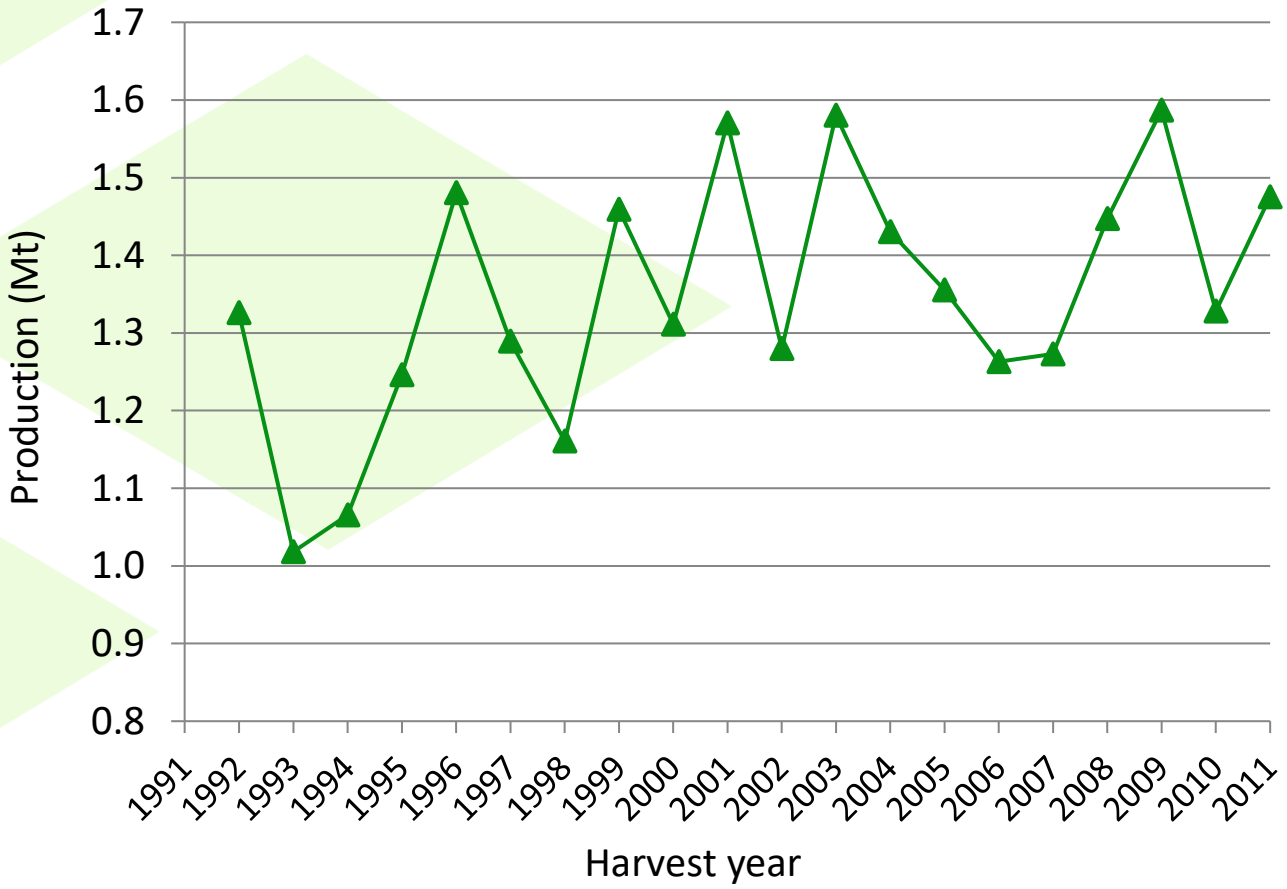
Scottish spring barley: Yield

Yield has not increased since 2000



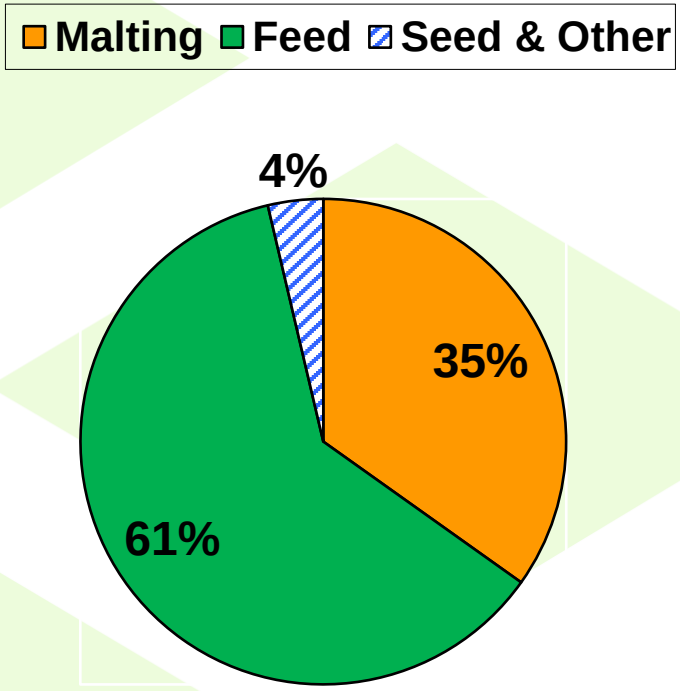
Scottish spring barley: Production

Production to remain high as demand increases



Malting represents almost half of Scottish barley use

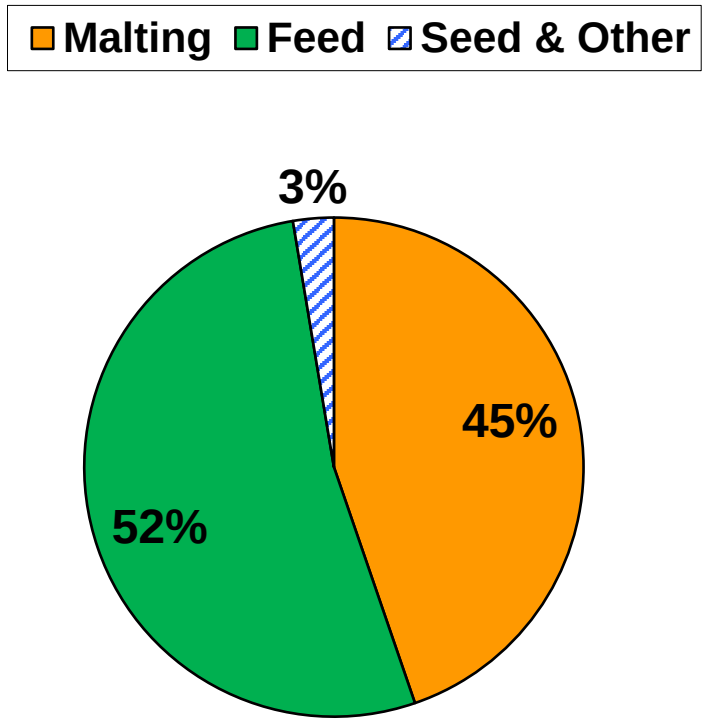
UK barley use



Total 5.2 mt

Source: Defra, Scottish Government and SAC

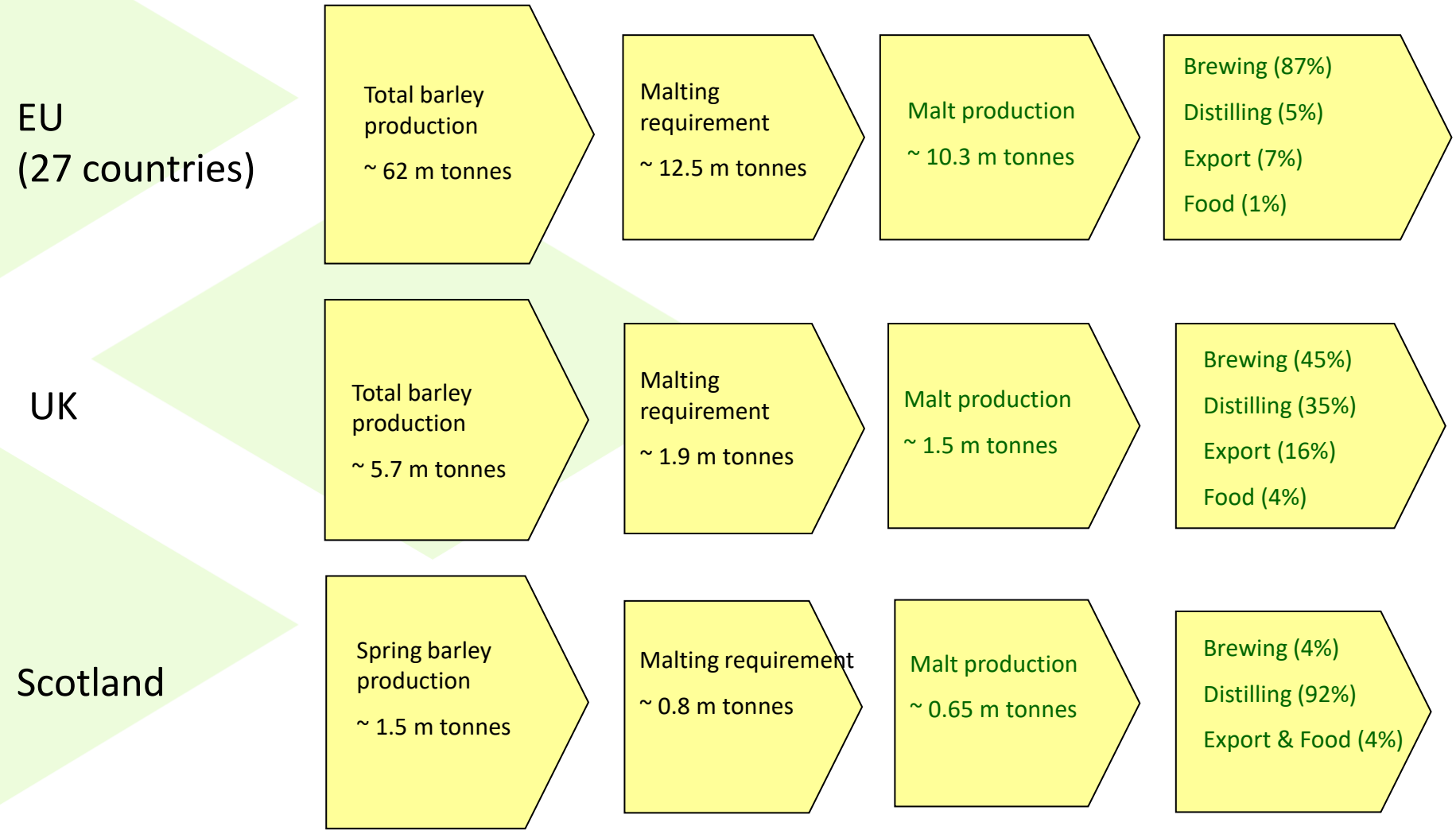
Scottish barley use



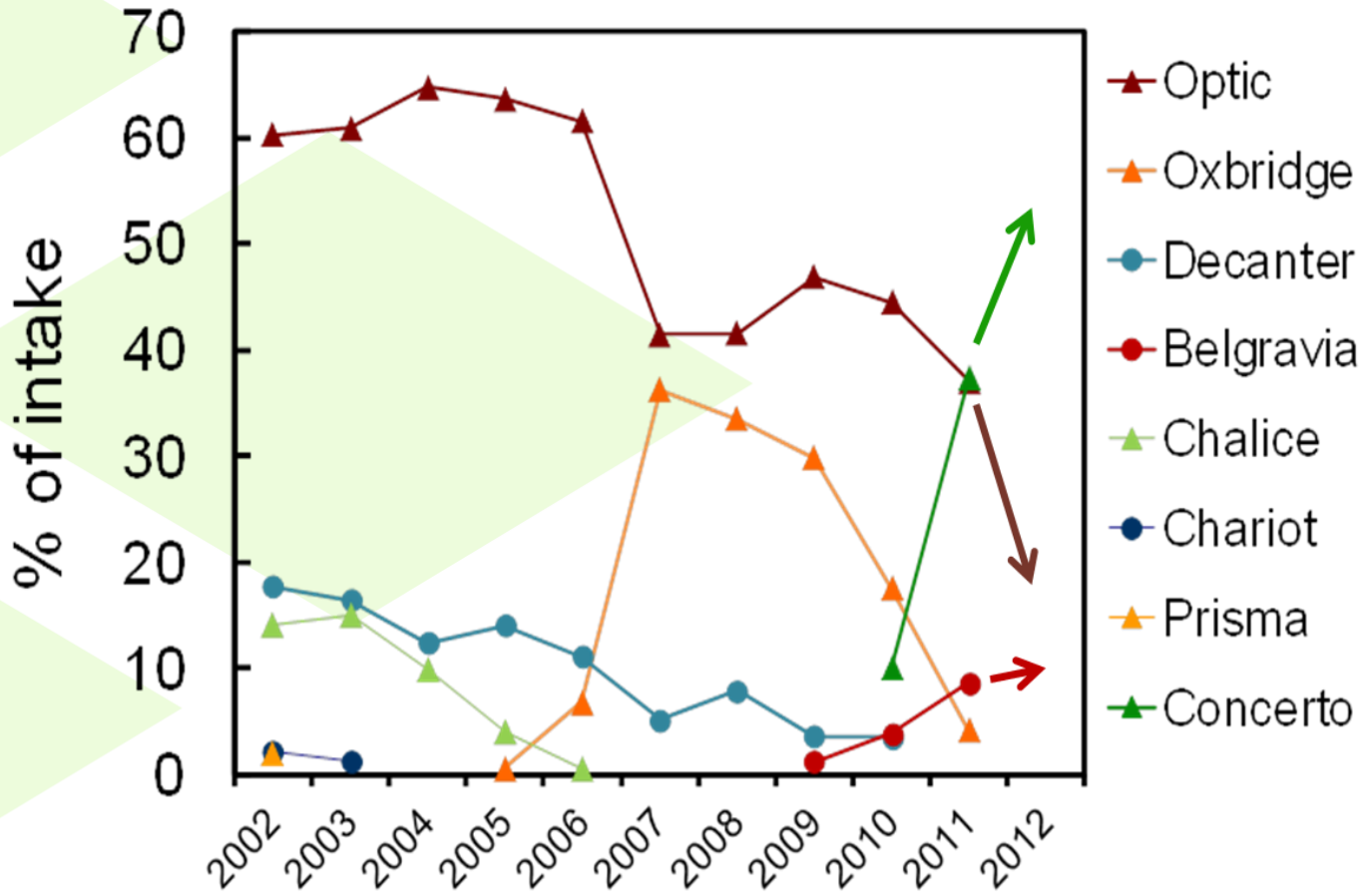
Total 1.8 mt

Domestic demand, excludes exports

Barley and malting usage: The importance of the distilling sector in Scotland



Spring barley malting intake



MAGB / SRUC

Different types of malt are required for two types of distilling

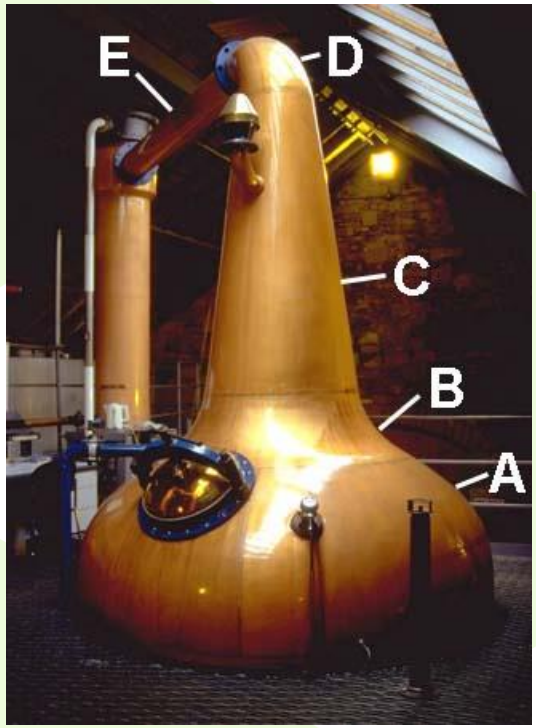
- Malts for the production of Scotch whisky (malt distilling)
  - Accounts for around 84% of malting barley purchases
  - Uses low grain nitrogen barley

- High enzyme (high diastatic power) malts for grain whisky (grain distilling)
  - Accounts for around 16% of malting barley purchases
  - Uses high grain nitrogen barley

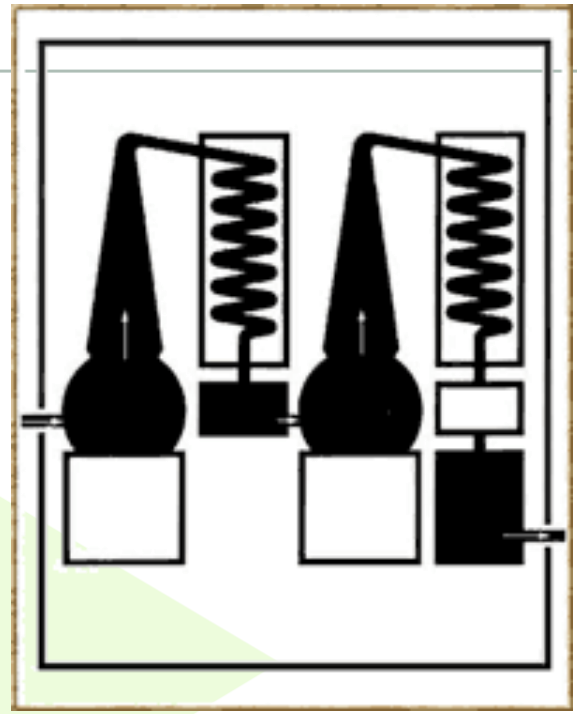
Different types of distilling

- Malt distilling (Scotch malt): 40% of annual spirit production
  - Utilises 84% of all malt production
  - Uses malted barley only
  - Malt → Grist → Wort (malt sugars) → Wash → into a batch process in Wash and Spirit stills
- Grain distilling (Scotch grain): 60% of annual spirit production
  - Utilises 16% of all malt production
  - Uses unmalted cereal (85-90%) plus barley malt (10-15%)
  - Cooked cereal → Slurry → + Malt → Wort → Wash → into a continuous process in analyser and rectifier towers

Malt distilling



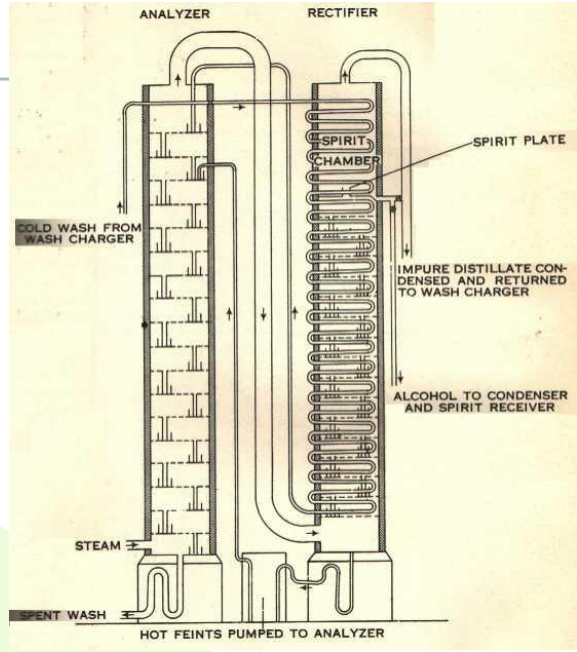
Copper pot still



Wash and spirit stills

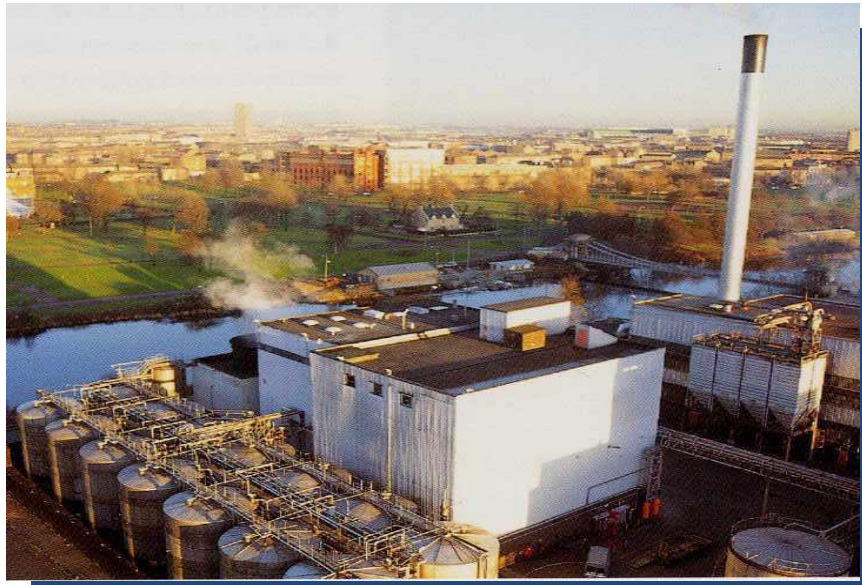
Malt distillery

Grain distilling



Two towers, analyser and rectifier

Patent or Coffey still



Grain distillery

The Scottish spring barley crop is dominated by a few varieties

Year first listed	Variety	Main use	Scottish area (%)	Maltsters intake (%)
1995	Optic	Malt distilling	20	35
2009	Concerto	Malt distilling	32	41
2008	Belgravia	Grain distilling	5	7
2010	Propino	Brewing & feed	4	2
2005	Waggon	Feed	20	---
2005	Westminster	Feed	7	---
	>20 others	All uses	12	15

The Scottish winter barley crop is dominated by feed varieties

Year first listed	Variety	Main use	Scottish area (%)	Maltsters intake (%)
1999	Pearl	Malting and feed	20	85
2007	Cassata	Malting	5	14
2005	Saffron	Feed	10	---
2010	KWS Cassia	Feed	12	---
2007	Retriever	Feed	14	---
2003	Sequel	Feed	12	---
2011	Escadre	Feed	3	---
2009	Volume	Feed	10	---

The Scottish / SRUC RL

SRUC

SAC Recommended List for Cereals 2012

Spring barley (Yield of 100 = 7.2 t/ha)

Year First Listed	Recommendation		Grain yield % treated Control	Yield loss (%) if un-treated	Use B=brewing, D=distilling, GD=grain distilling	IBD Malting Approval†	Screenings <2.5 mm	Specific weight kg/hl	Resistance to ear loss 1-9	Maturity days +/- Optic	Straw strength 1 to 9 weak-strong	Straw length cm	Brackling risk 1 to 9 high-low	Disease resistance 1 susceptible to 9 resistant		
														Mildew	Rhyncho-sporium	Ramularia
2012	P1	Odyssey	108	12	B & D	T	[3.7]	67.8	[7]	+1	[6]	73	8	9	7	(5)
2012	P1	Chronicle	107	12	B & D	T	[3.8]	67.5	[7]	+1	[8]	74	8	8	7	(6)
2005	R	Waggon	106	12	Feed	No	-	67.4	7	-1	8	73	8	9	3	(7)
2010	R	Propino	105	11	B	F	2.7	66.9	7	0	8	76	8	8	7	(7)
2011	P2	Shuffle	105	12	B & D	P(1)	2.9	66.9	6	+1	[9]	77	8	9	6	(6)
2012	P1	Overture	104	8	B & D	T	[3.4]	67.7	[7]	+1	[6]	75	8	8	7	(6)
2007	O	Quench	104	12	B	F	4.5	67.6	8	+1	8	71	8	9	8	(5)
2009	R	Concerto	101	12	B & D	F	2.8	68.1	7	+1	6	78	8	8	4	(6)
2011	P2	Moonshine	101	12	B & D	P(1)	3.1	67.1	6	0	[6]	71	8	8	4	(5)
2008	R	Belgravia	100	9	D & GD	F	3.7	68.2	7	+1	7	76	8	9	8	(6)
2005	R	Westminster	99	9	Feed	No	3.0	70.0	7	+2	6	82	7	9	8	(6)
1995	R	Optic	96	16	B & D	F	4.7	69.7	6	0	8	75	4	5	4	(6)

Winter barley (Yield of 100 = 8.5 t/ha)

Year First Listed	Recommendation		Grain yield % treated Control	Yield loss if un-treated %	Suitability to lighter soils	IBD Malting Approval†	Screenings <2.5 mm	Specific weight kg/hl	Resistance to ear loss 1-9	Maturity days +/- Pearl	Straw strength 1 to 9 weak-strong	Straw length cm	Disease resistance 1 susceptible to 9 resistant				
													Mildew	Rhyncho-sporium	Net Blotch	Ramularia	BaMMV R=resistant
2009	R	Volume	116	18	Good	No	12.7	68.4	7	-2	6	98	6	8	6	(7)	R
2011	P2	Element	115	21	Good	No	4.5	67.9	6	-3	6	101	6	6	7	(5)	R
2012	P1	KWS Meridian	114	19	Good	No	5.0	65.6	7	-2	7	102	9	6	[8]	(6)	R
2007	R	Retriever	111	23	Good	No	-	66.8	8	-1	7	81	6	6	5	-	R
2011	P2	Escadre	108	18	Good	No	6.6	69.6	7	-2	6	95	5	8	8	(7)	R
2010	R	KWS Cassia	107	17	Good	No	3.6	70.5	7	-1	7	85	5	4	7	(7)	R
2011	P2	Florentine	105	19	Moderate	No	5.2	68.1	8	-2	8	85	6	7	7	(6)	R
2003	R	Sequel	105	19	Moderate	No	10.9	69.2	7	-2	6	98	5	8	6	(6)	R
2005	O	Saffron	100	18	Moderate	No	4.5	70.1	8	0	8	85	3	4	8	(6)	
2007	S	Cassata	98	17	Moderate	F	3.3	68.1	7	0	8	85	4	8	4	(5)	R
1999	R	Pearl	95	15	Moderate	F	3.3	70.2	7	0	7	94	6	6	5	(7)	

Colour code: Good | Tends to be good | Intermediate | Tends to be poor | Poor

Sowing spring 2013: Market leaders

	Concerto	Optic	Belgravia	Propino
Use (IBD)	D, B	D, B	D, GD	B
NE yield	99	95	97	104
uT yield	89	78	88	92
Lodging	6	7	7	8
Height	77	74	76	75
Ripening	+1	0	+1	+1
Brackling	7	5	8	8
Screenings (2.5mm)	2.7	4.5	3.7	2.4
Mildew	8	5	9	8
Rhynchosporium	4	3	7	7
Ramularia	6	5	7	6

Data from HGCA Recommended List Trials

Sowing spring 2013: Varieties establishing market position

SRUC

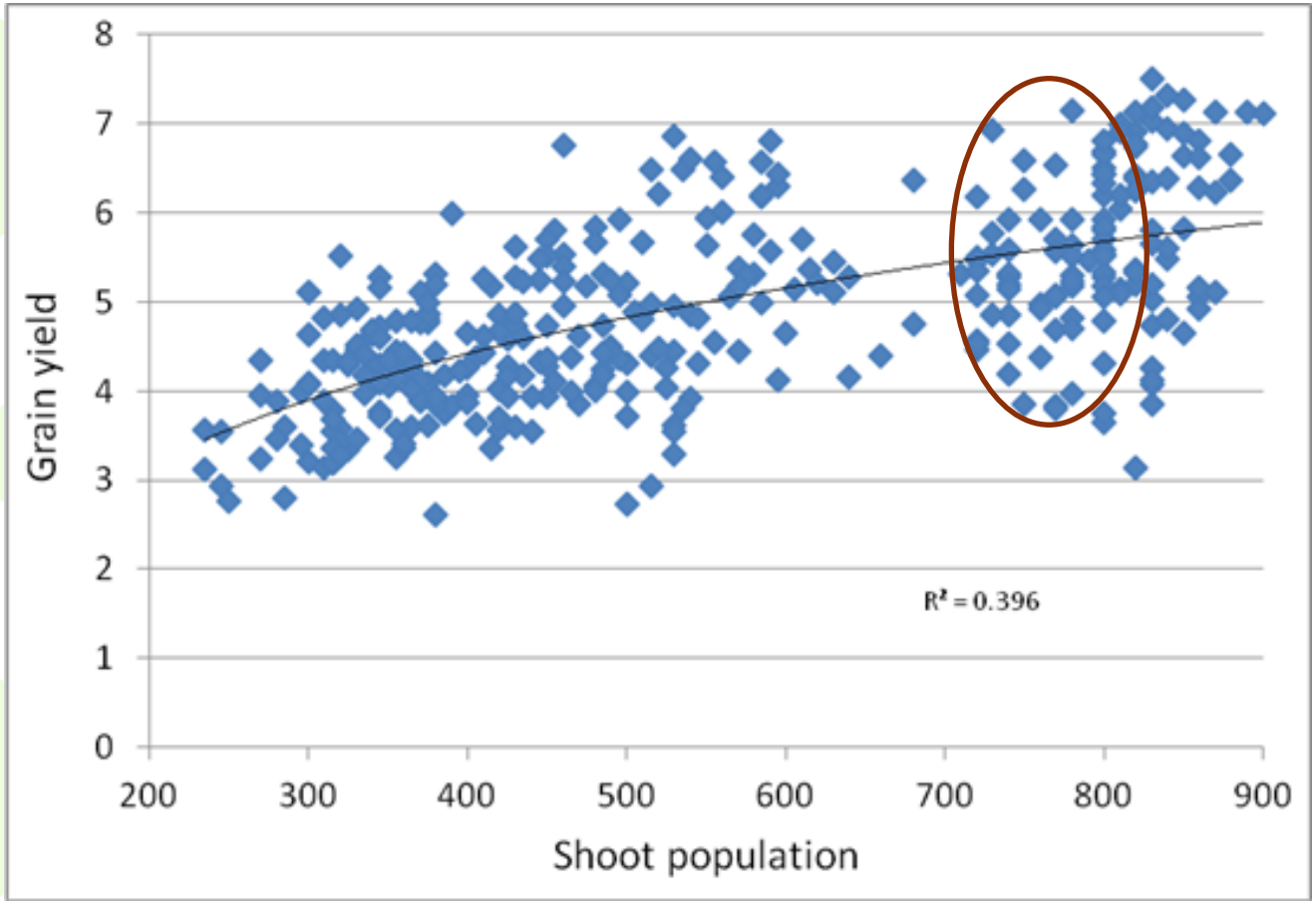
	Odyssey	Chronicle	Overture	Moonshine
Use (IBD Provisional)	D, B	D, B	D, B	D
UK yield	106	104	103	100
NE yield	106	105	103	100
uT yield	92	91	94	87
Lodging	[5]	[7]	[7]	7
Height	72	73	74	71
Ripening	+2	+1	+2	0
Brackling	8	8	7	7
Screenings (2.5mm)	3.4	3.9	3.7	3.2
Mildew	9	8	8	8
Rhynchosporium	7	6	6	4
Ramularia	6	7	6	5

RECOMMENDED HGCA

Seed rates in spring barley

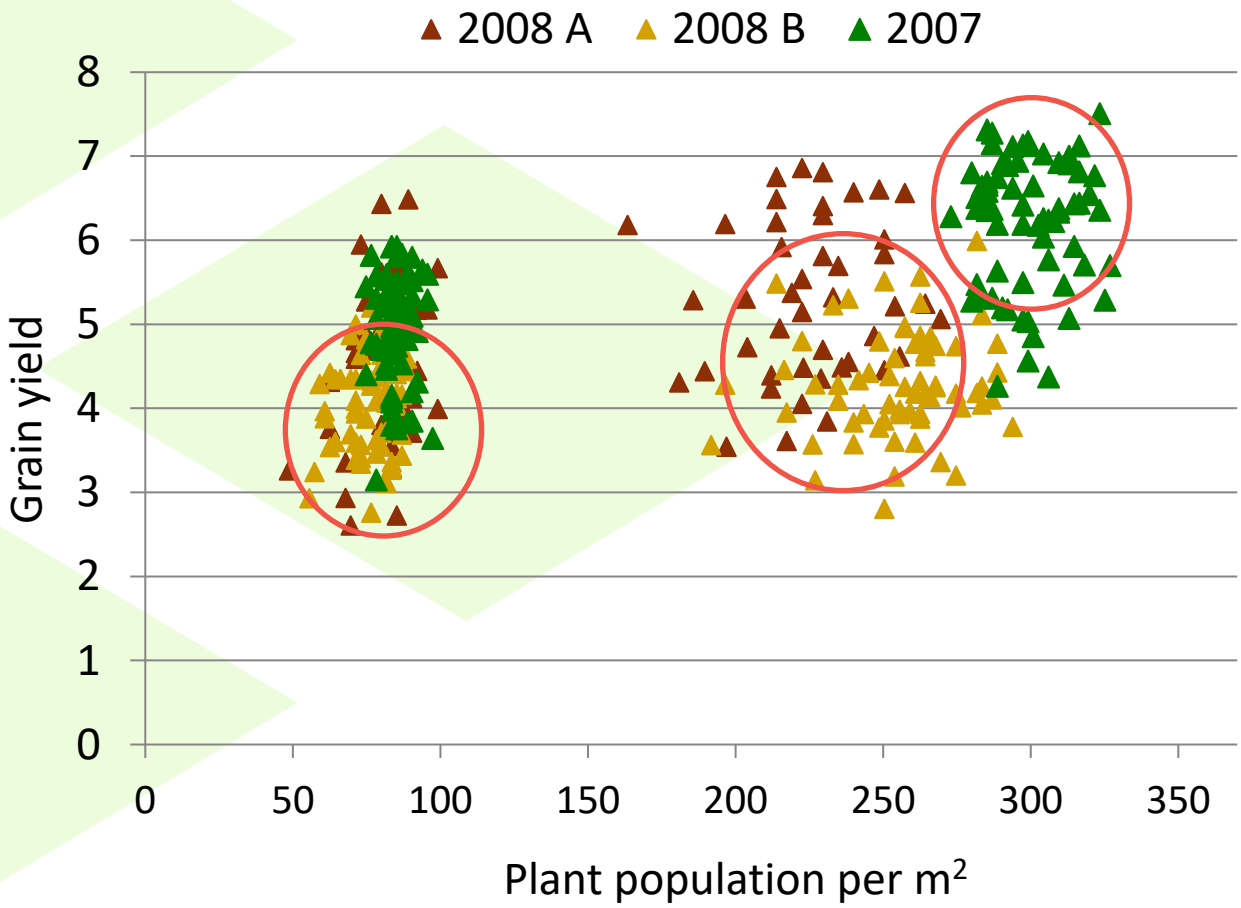
- Aim for a target plant population between 300 to 325 plants per m^2
- Modern varieties produce 2 or 3 fertile ears per plant
- Optimal ear population is between 700 to 800 per m^2
- Optimising ear number reduces the risk of grain quality problems:
    - above the optimal, grain size is reduced and screenings increase
    - yield dilution of grain N% is less effective at high plant numbers
    - low plant (or ear) number may result in excessive grain filling, increasing the risk of skinning

Ear number per m^2 is important …



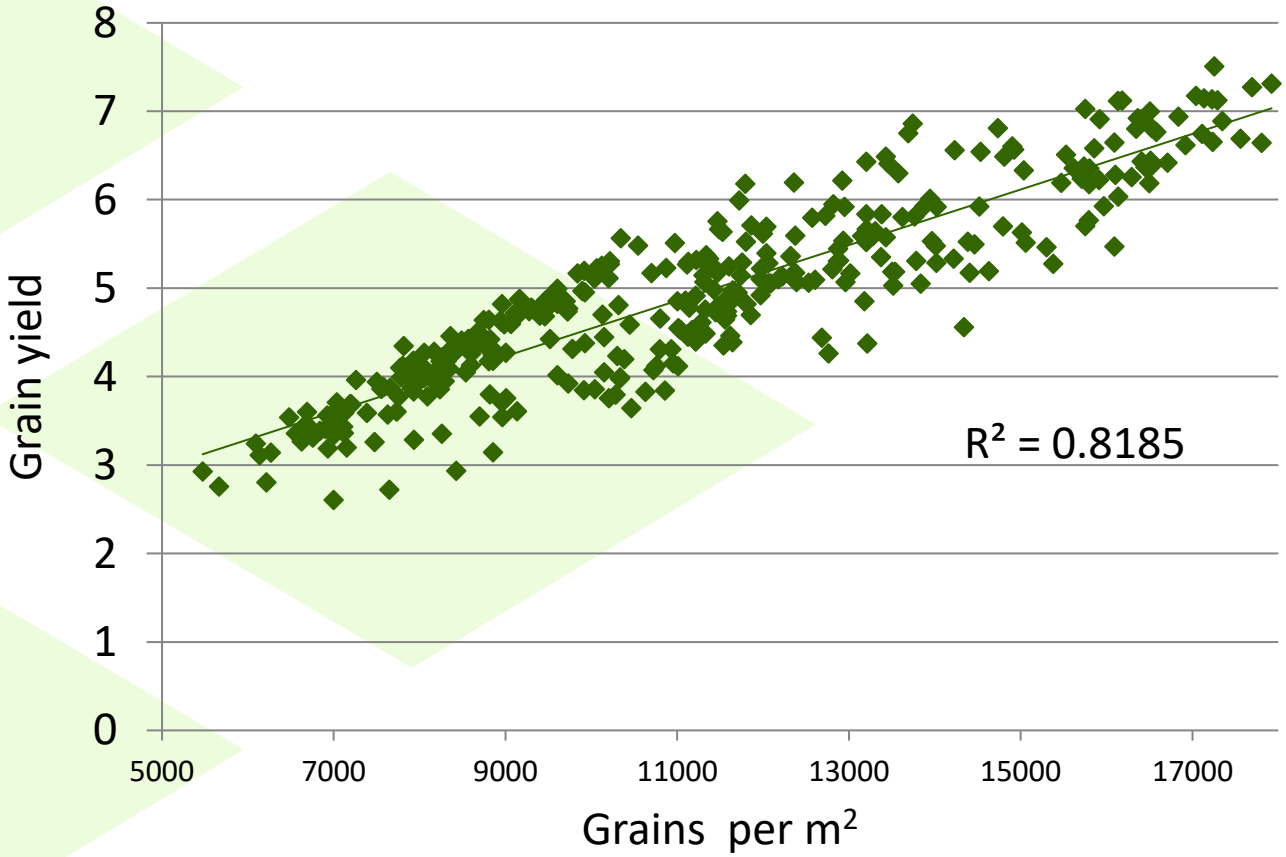
… key is to optimise shoot population by seed rate (plant population)

Ideal plant population is 300-325 per m^2



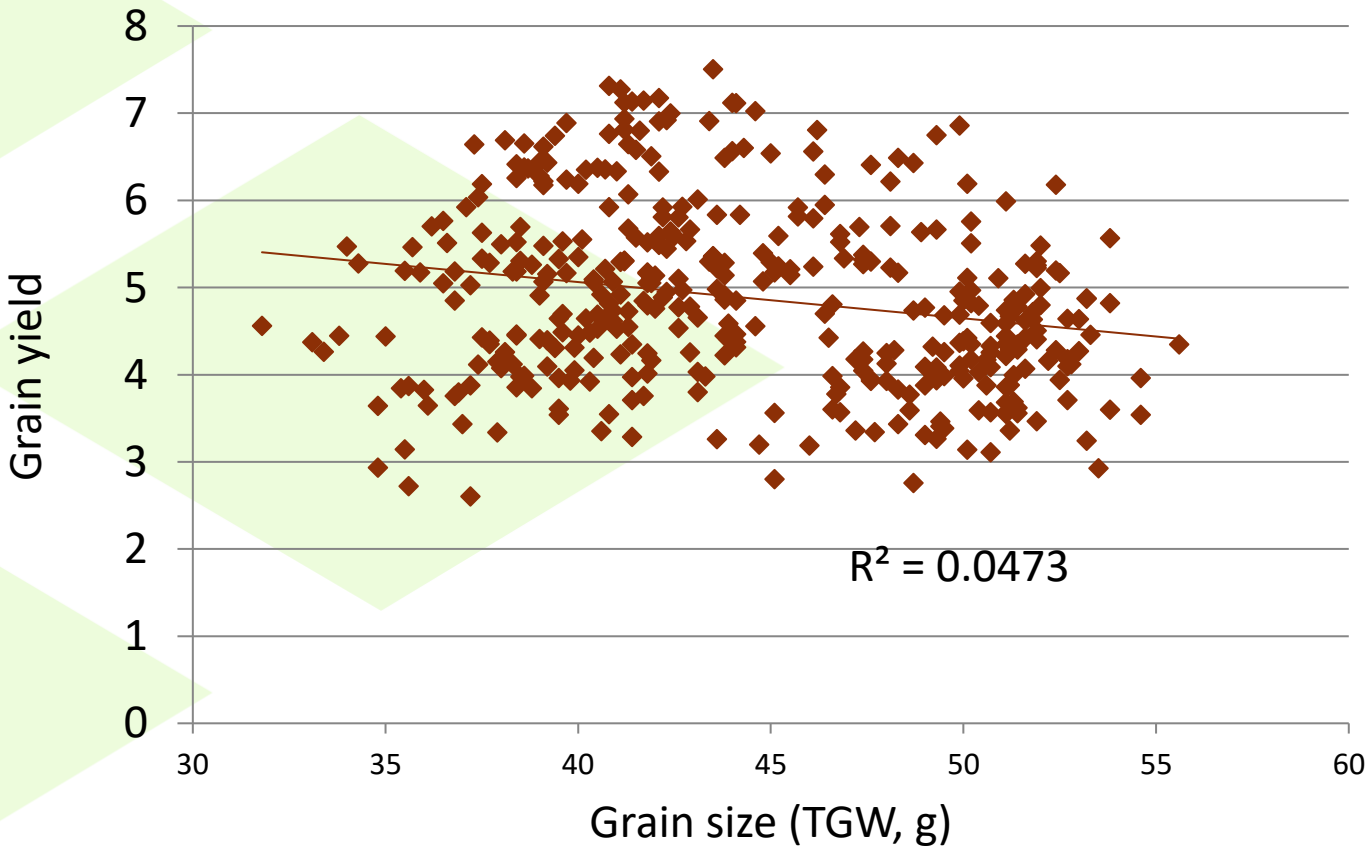
Risk of yield loss if plant population is too low, especially if sowing late or into a poor seed bed

Yield is driven by grain number …

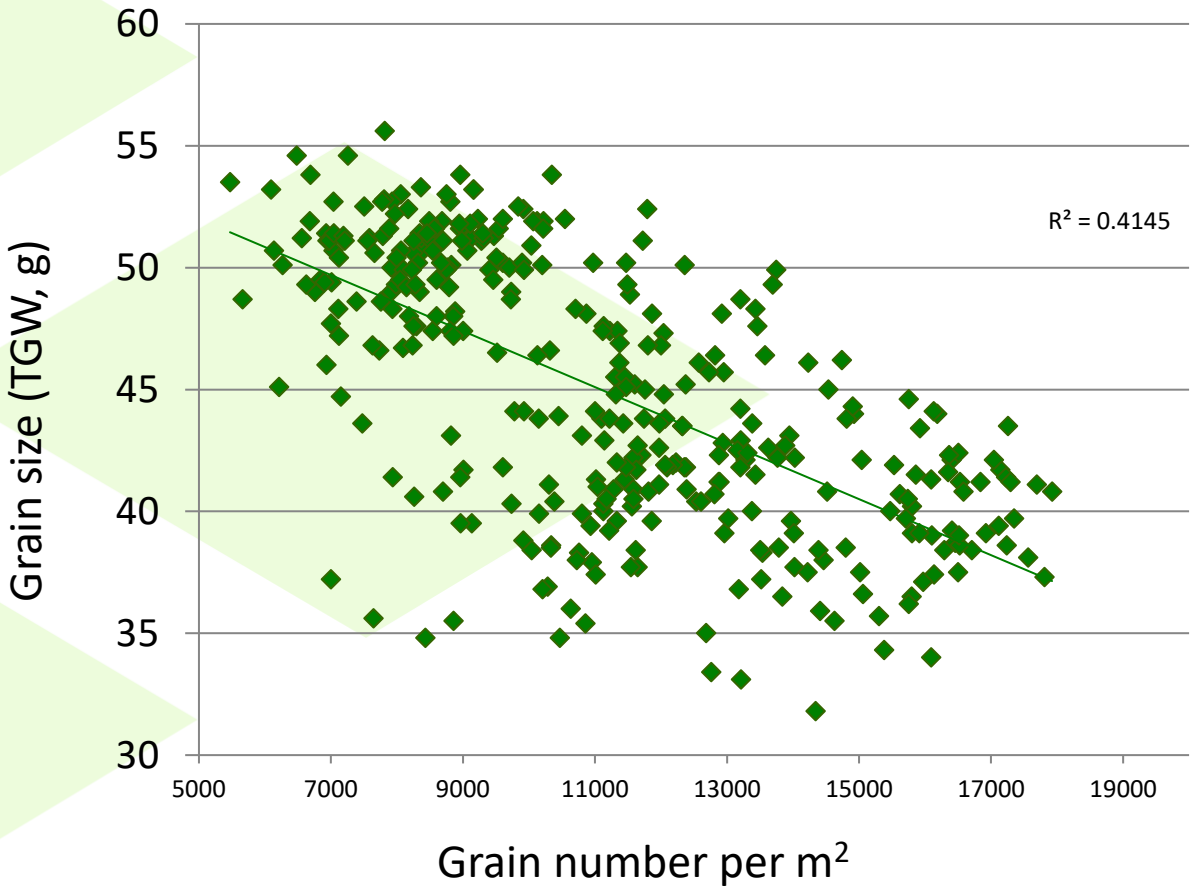


… which is a balance of ear number and ear size

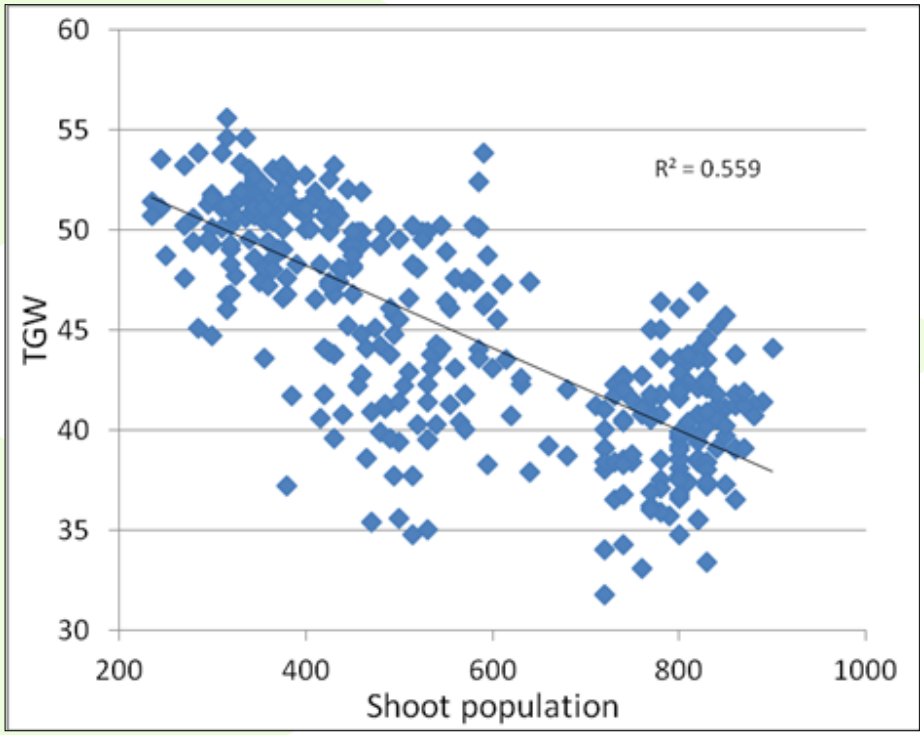
Grain size is less important than number in yield creation, but has big impact on quality

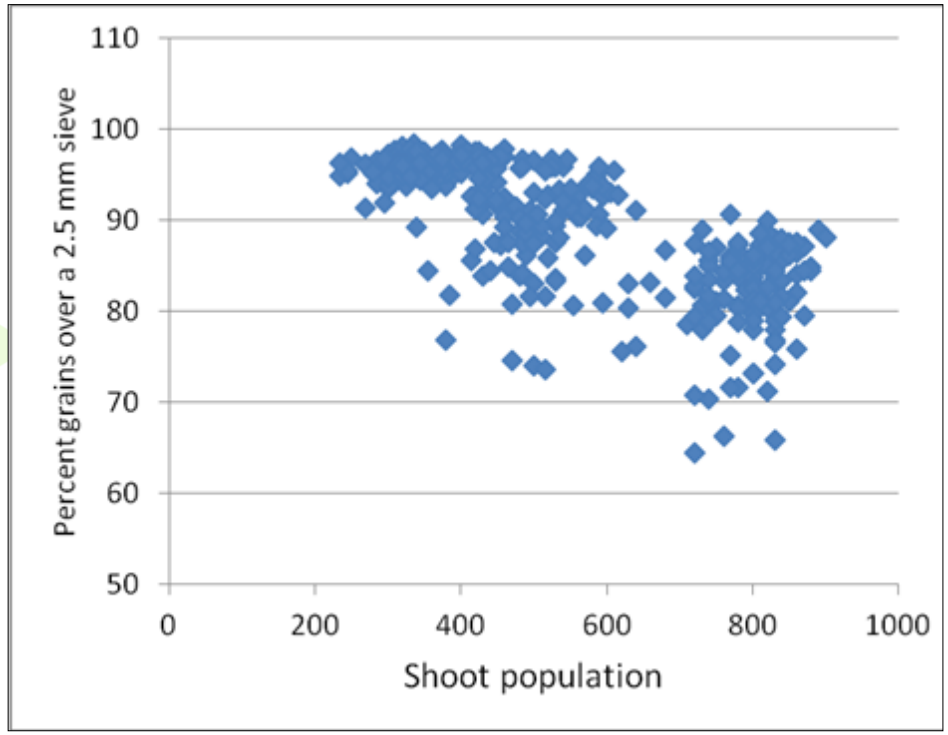


Increasing grain number reduces grain size



Excessive shoot population (or seed rate) increases the risk of screenings





Seed rate calculation

Seed rate calculations should be based on seeds sown per m^2 by taking into account thousand corn weight (TCW)

(This is important as seed size varies between varieties, and also between bulks and seasons)

To work out seed rate in kilos per hectare

Multiply ‘seeds sown per square metre’ by ‘thousand corn weight in grammes’ and divide by 100

Factors to consider when calculating seed rates

- The starting point is 350 to 375 seeds per m^2
- Sowing into a good seed bed from early March to early April establishes a plant population between 80% to 90% of the seed number sown
- Under the very best seed bed conditions the seed rate for early sowing can be reduced by 10%.
- If the seed bed is not ideal, then increasing the seed rate by 10% to 20% will help to buffer against lower plant establishment
- In later sown crops there are likely to be fewer ear bearing stems per plant, though this is often compensated for by a higher percentage establishment
- On balance, seed rate can be increased by 5% if sowing up to four weeks late, or by 10% if sowing later still

Optimising ear number

Ear number = Seeds sown × Establishment × Tillering

e.g. 350 seeds × 0.8 × 2.5

= 280 plants per m^2

= 700 ears per m^2

$$\text{Seed rate (kg/ha)} = \frac{\text{Plants per } m^2 \times \text{TGW (g)}}{\text{Establishment (\%)}}$$

Optimising plant number: What is expected percentage crop establishment?

Establishment (%) is affected by sowing date and seed bed

Sowing date	Seed bed conditions: Good	Mod	Poor
Early	85	70	60
Normal	90	80	70
Late	95	85	75

[HGCA Report 179/SAC]

Adjust seed number according to expected establishment and tillering ability

Seed number m^2 = 300 plants × % expected establishment ± 10% depending on early or late sowing

		Seed bed conditions			
		Good	Mod	Poor	Tillering
Sowing date	Early	320	380	450	High
	Normal	330	375	430	Mod
	Late	350	390	440	Low

Varieties and seed rates

- Sowing by seed number reduces the risk of ear populations being too dense in small-grained or high tillering varieties such as Optic, or too sparse in bold-grained varieties such as Shuffle
- Propino tends to be at the upper end of the range for grain size
- Optic and Belgravia are at the lower end
- Concerto and Moonshine are intermediate
- The new the varieties Odyssey, Overture and Chronicle tend to be intermediate, with Odyssey being the boldest of this group
- These varietal differences are not a concern as long as plant number and TCW are factored into your seed rate calculations

Amount and timing of nitrogen fertiliser

Spring crop

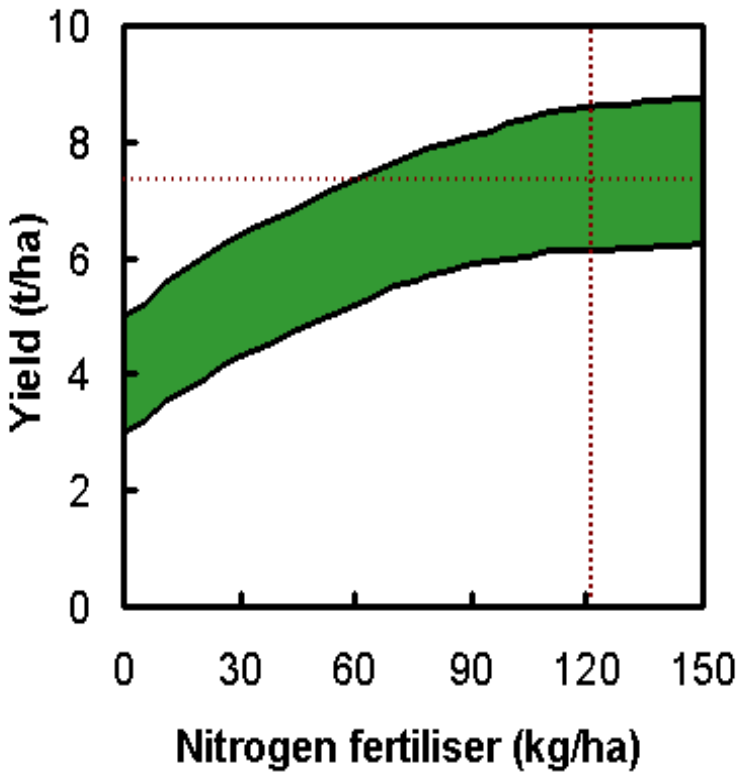
Nitrogen fertiliser for malting crop is 80-90% that of a feed crop

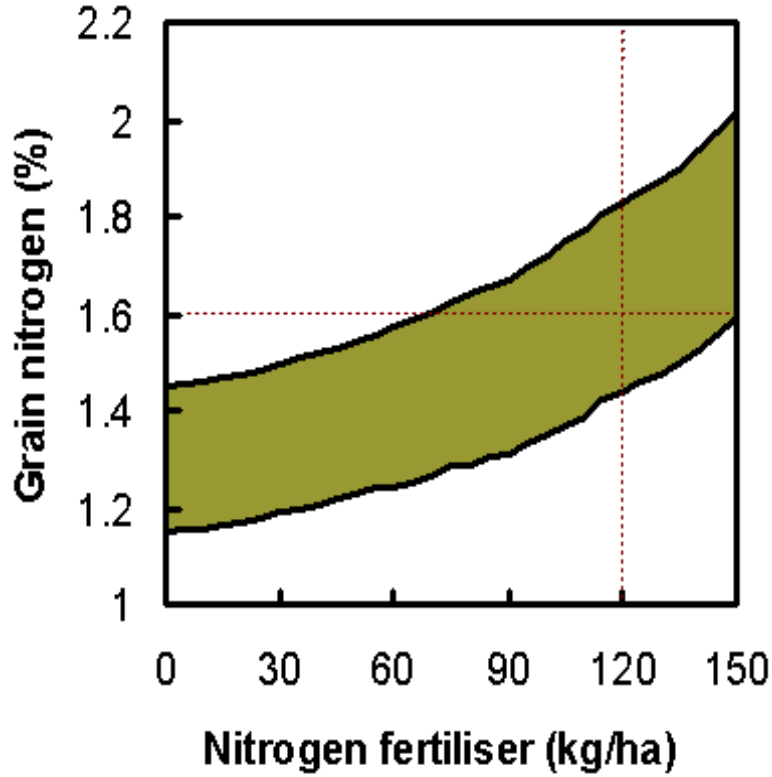
- Spring feed (e.g. 130 kg N/ha) *v* spring malting (110 kg N/ha)
- Requirement falls by 1-2 kg / ha / day after optimum sowing date
- N timing is usually split according to sowing date:
  - To late February: up to 1/3 in seed bed
  - To end of March: 1/2 in seed bed, 1/2 at leaf three
  - April onwards all in seed bed

[HGCA Report 179/SAC]

Grain yield and nitrogen % responses to nitrogen fertiliser

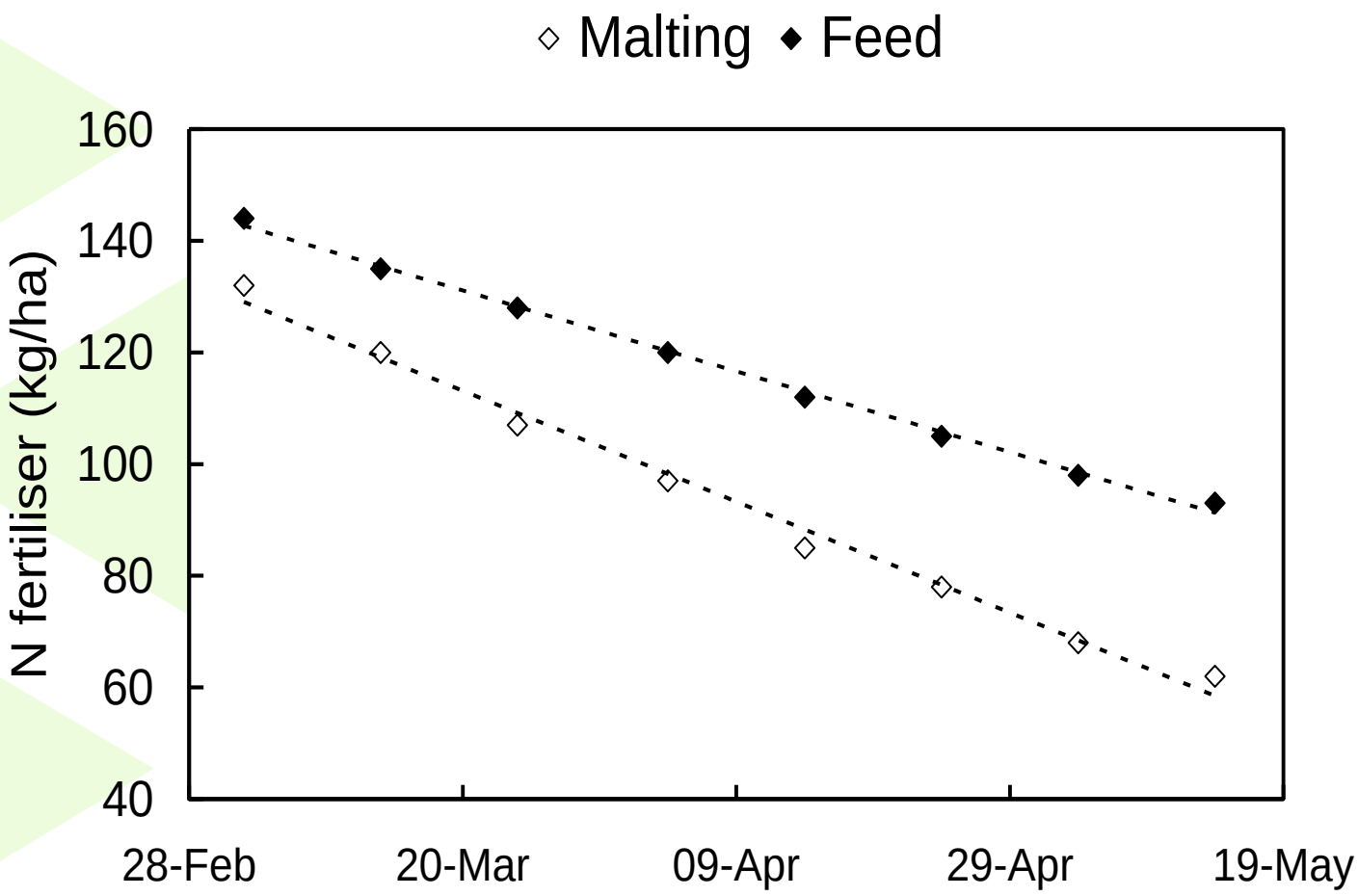
Range of grain yield and N% across applied fertiliser nitrogen





[RERAD/SAC trials]

Nitrogen fertiliser requirement changes with sowing date



[HGCA/SAC trials]

HGCA/SRUC Agronomy 2014

Wednesday 15 January – Perth
Nelson Stand, Perth Racecourse

09:30 **Registration**

10:00 **Chairman's welcome**
Gavin Dick – Regional Manager (Scotland), HGCA

10:05 **Market position**
Julian Bell – Senior Rural Business Consultant, SRUC

10:25 **Crop update: quality issues**
Simon Oxley – Senior Research & KT Manager, HGCA

10:50 **Crop update: variety choice from grower, breeder and industry perspectives**
Steve Hoad – Leader, Crop Science Team, SRUC

11:20 **Discussion**

11:35 **Refreshments**

12:05 **Managing disease risk over contracting seasons**
Fiona Burnett – Leader, Crop Protection, SRUC

12:30 **Biology and control of the key Scottish pathogens, Ramularia on barley and light leaf spot in rape**
Neil Havis – Plant Pathologist, SRUC

12:55 **Control of WOSR pests in the absence of neonicotinoid seed treatments**
Andy Evans – Applied Practice Team Leader, SRUC

13:15 **Discussion**

13:30 **Lunch**

Crop protection session

14:30 **Understanding soil physical conditions**
Bruce Ball – Senior Soil Scientist, SRUC

14:55 **Importance of soil biology**
Bryan Griffiths – Senior Soil Scientist, SRUC

15:15 **Management practices and soil resilience**
Blair McKenzie – Senior Soil Scientist, JHI

15:45 **Discussion**

16:05 **Shaping the direction of arable research (2015-2018)**
Vicky Foster – Senior Research & KT Manager, HGCA

16:15 **Closing remarks**
Gavin Dick – Regional Manager (Scotland), HGCA

16:30 **Tea and depart**

Soil management session