

Impact, management and control of clubroot disease in the UK

Professor Fiona Burnet, Scotland's Rural College
Dr Julie Smith, ADAS

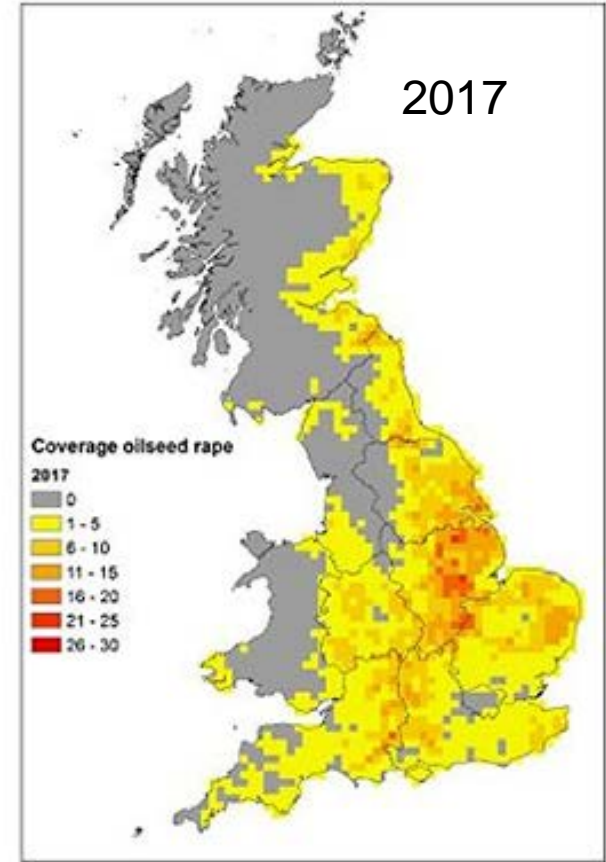
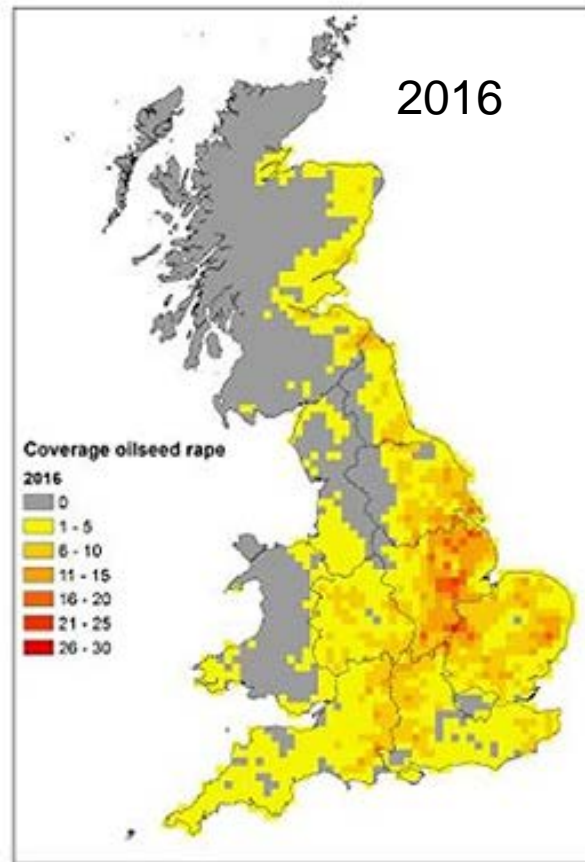
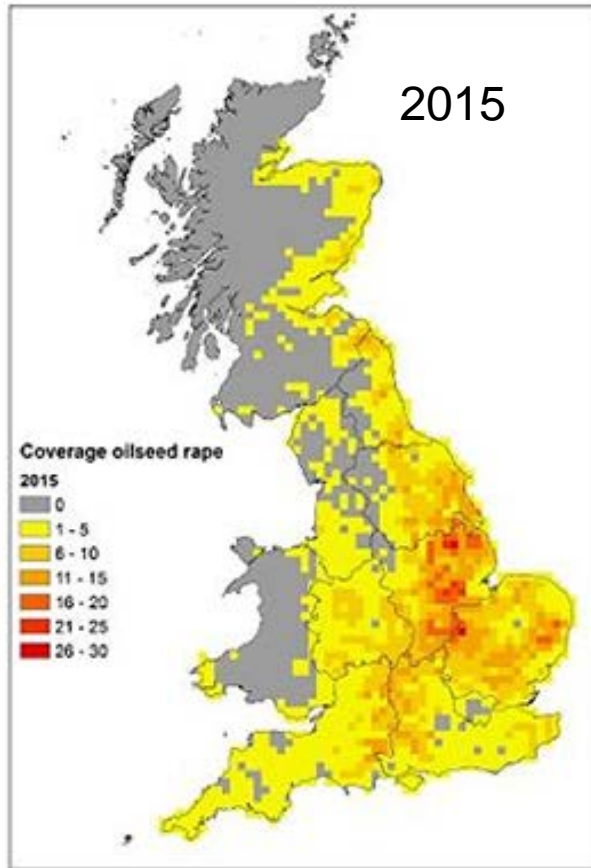


Introduction:

- Oilseed rape (canola) is one of UK's most profitable crops (2nd only to wheat)
- Equally useful as a break crop in rotations
- Scotland's most common break crop
- Clubroot a major issue
- Available control measures incomplete



UK oilseed rape distribution



OSR yields – 3 to 4 t/ha
3.6 t/ha (64 bushels / acre) =
gross margin £667 /ha or >\$400/acre)

Clubroot a major issue in UK soils

Survey 2008,2009, 2010



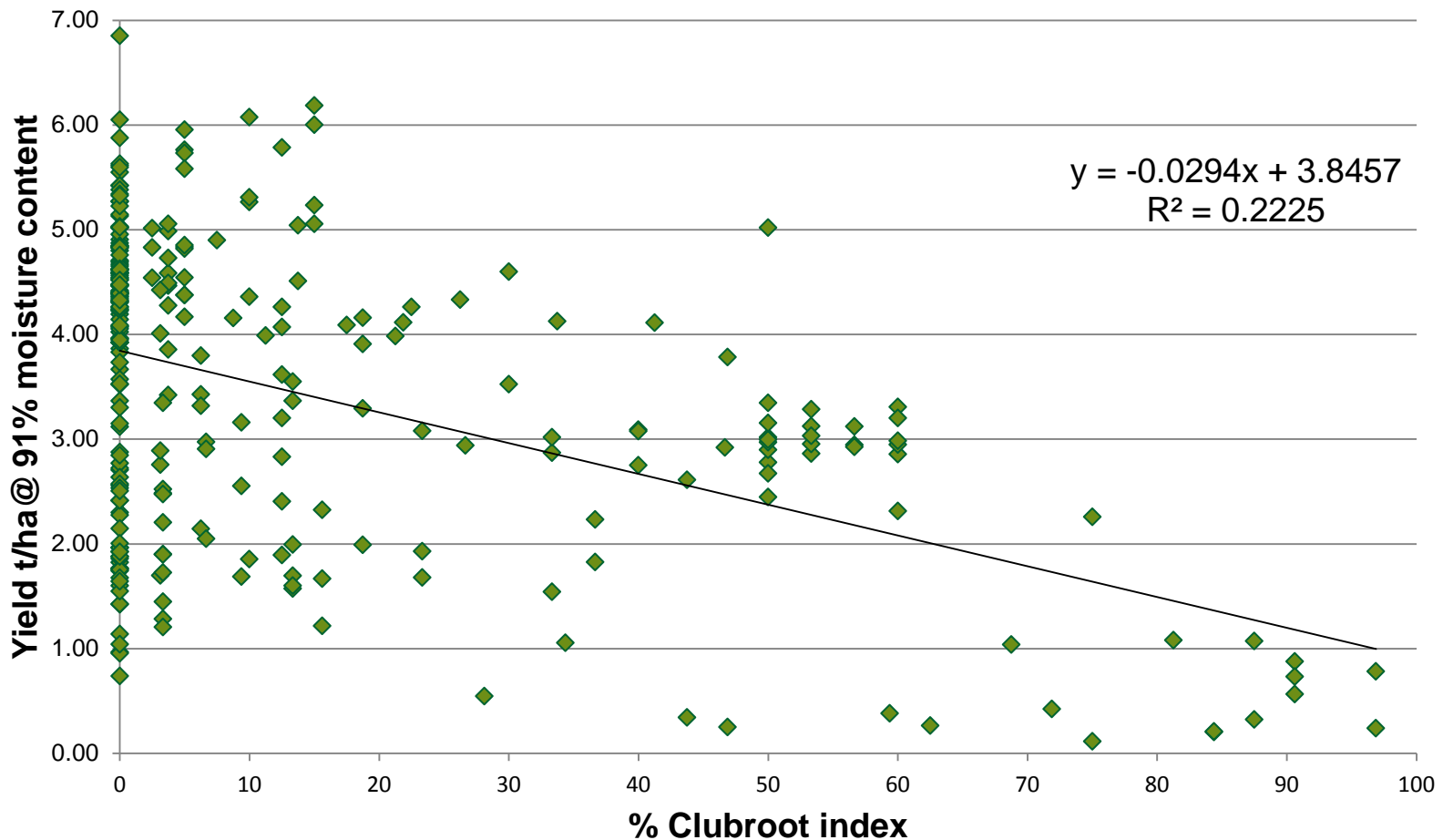
- 96 sites
- Chinese cabbage bioassay used
- Agronomists / consultants used so a probable bias towards fields of concern
- 52% samples positive
- UK strategy of testing and rejecting infected fields is unsustainable as clean land is a diminishing resource

Significant yield losses

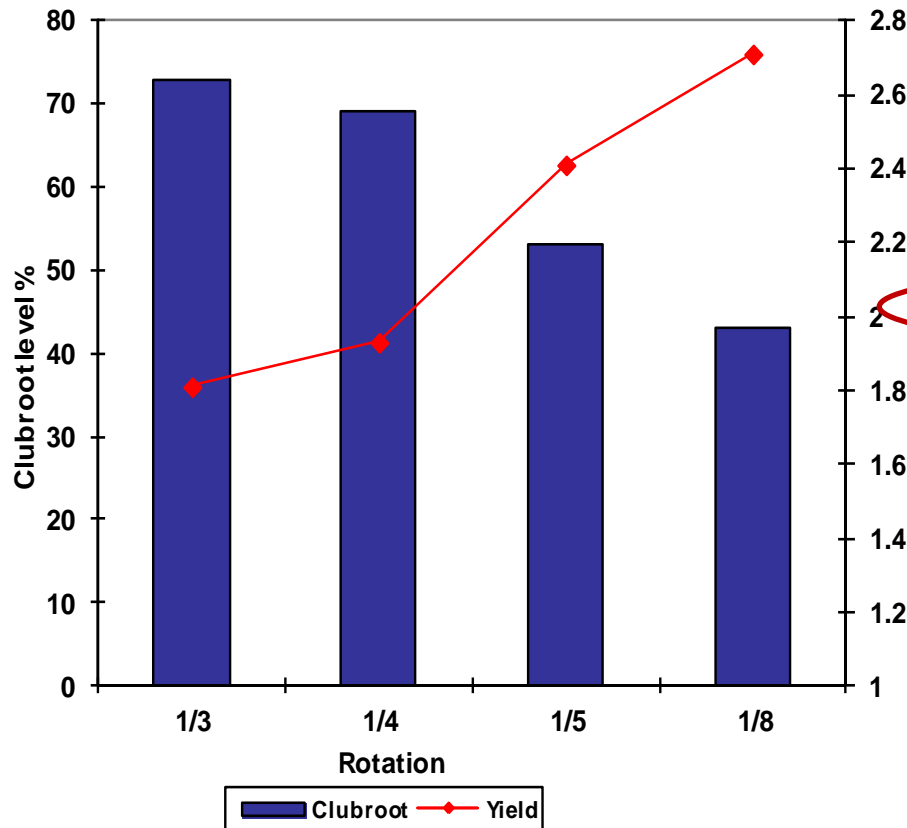


Losses can be 100% where crop is abandoned and ploughed back in

Correlation between yield and clubroot severity across all varieties and sites showing a 0.03 t/ha loss per each 1% increase in disease severity (3 year project across 6 trial sites)



Poor rotational practices have exacerbated problem - knowledge on optimal long term rotations required



1 in 3 rotation = 63 % potential yield
1 in 4 rotation = 65 % potential yield
1 in 5 rotation = 74% potential yield
1 in 8 rotation = 80 % potential yield

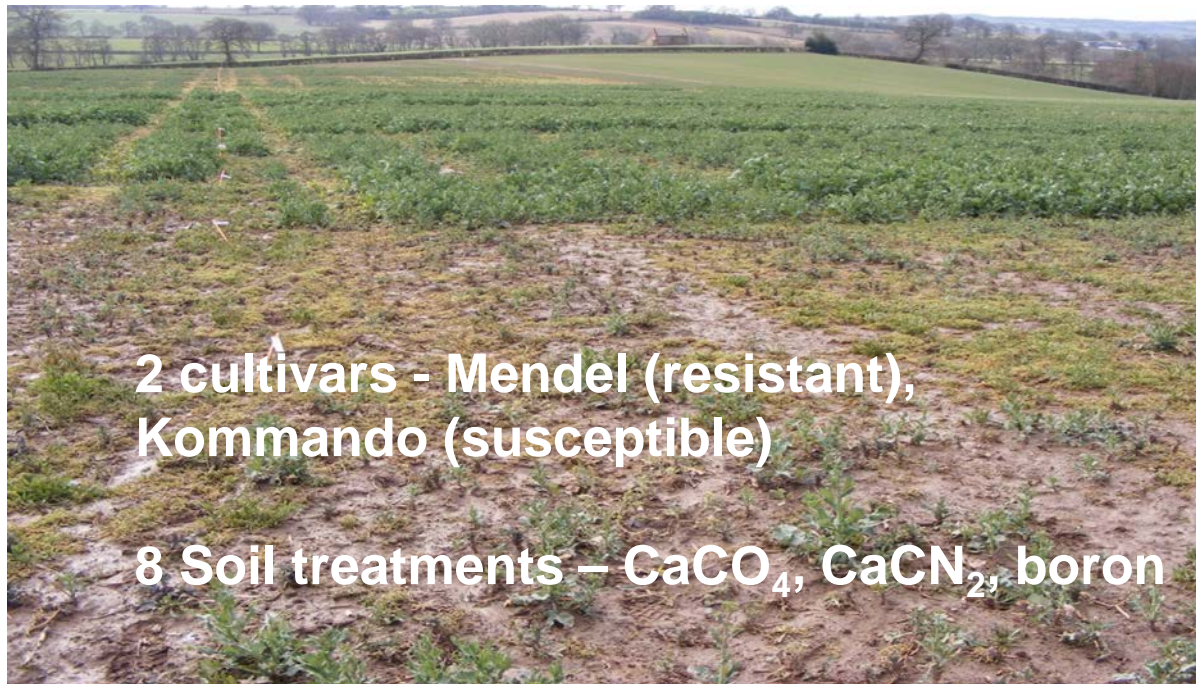
After Wallenhammer (1996) showing the clubroot severity in fields following the previous crop of oilseed rape, with crop yield overlaid assuming losses of 0.03 t/ha per % severity of clubroot in a 4 t/ha crop

Efficacy of management options incomplete

Field trials across 6 UK sites



AHDB project RD-2007-3373



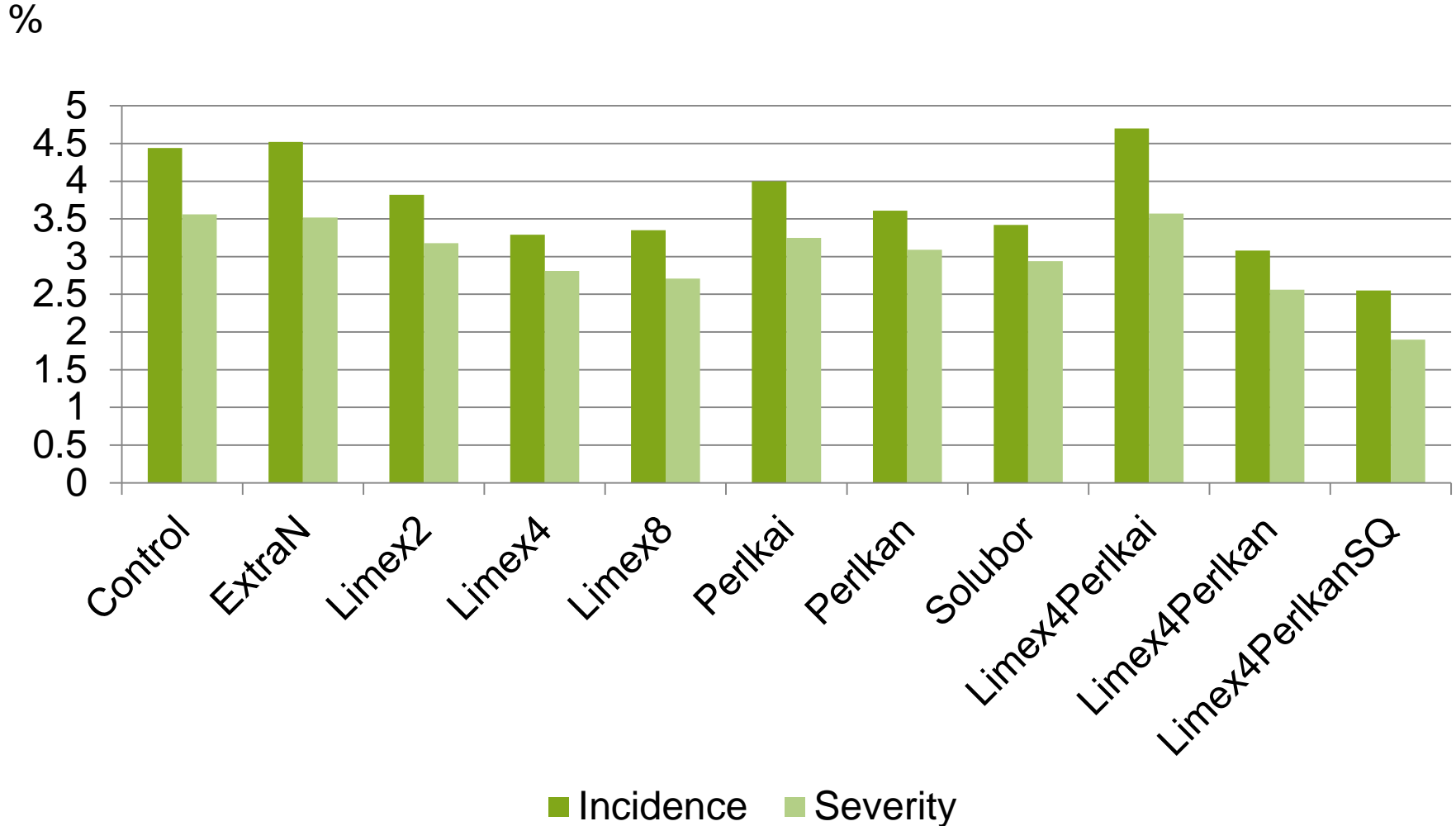
2 cultivars - Mendel (resistant),
Kommando (susceptible)

8 Soil treatments – CaCO_4 , CaCN_2 , boron

Shropshire field trial site showing susceptible Kommando plot foreground and resistant Mendel in the background, spring 2008 .

Clubroot control

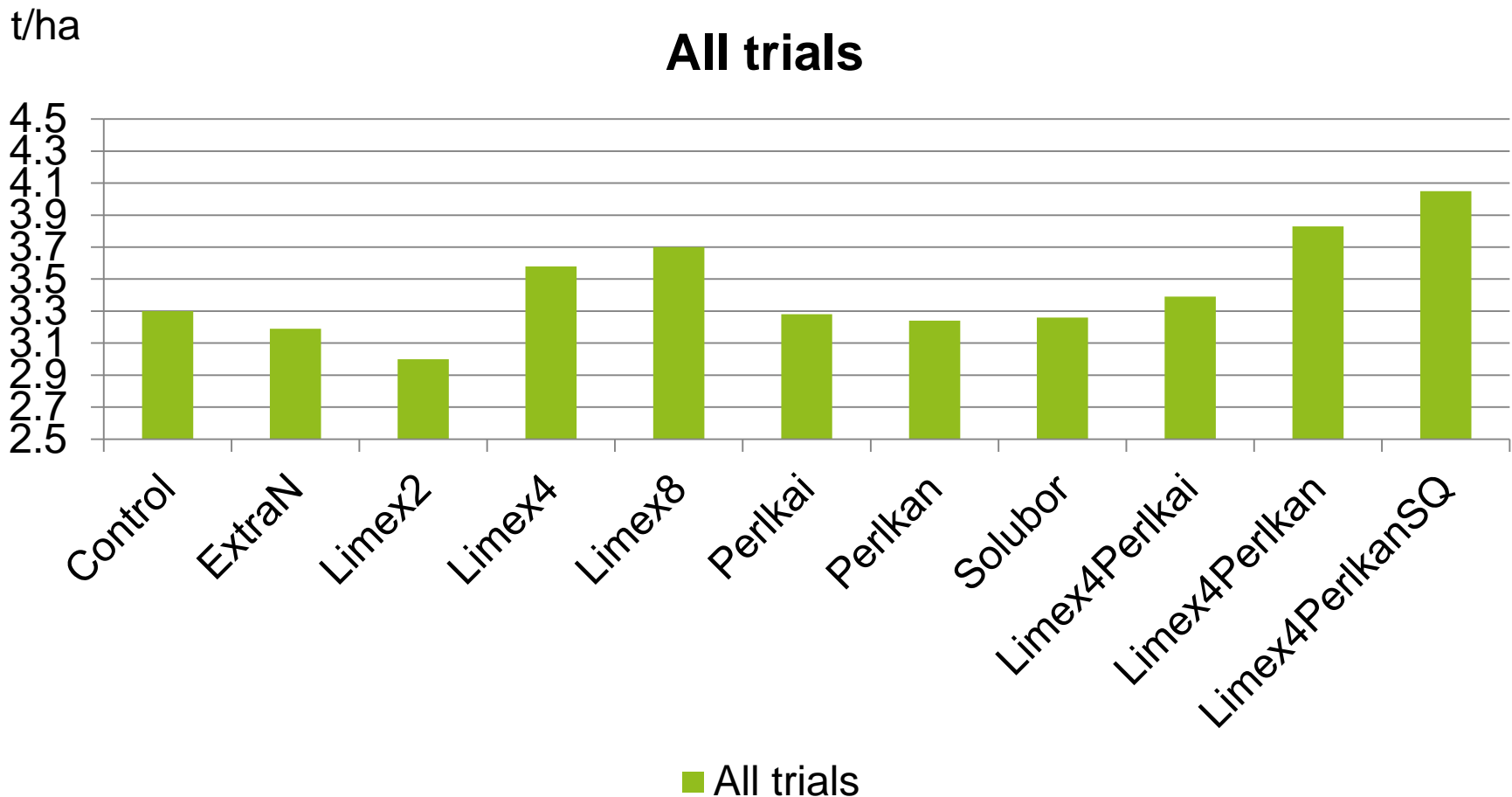
– predicated means in cross site analysis (6 sites)



Yield t/ha after soil treatment



- predicated means in cross site analysis (6 sites)

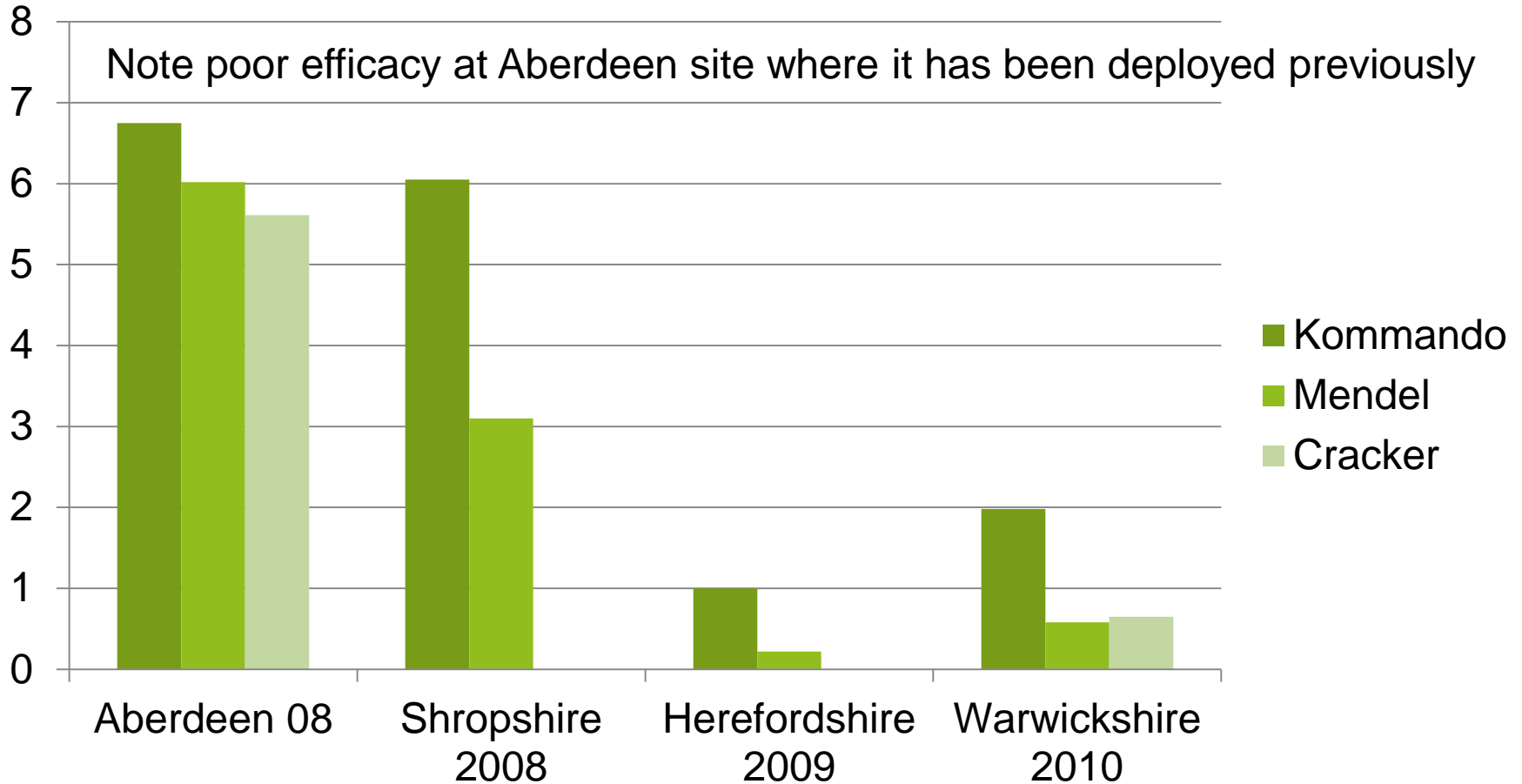


Limited varietal resistance to clubroot

- Heavy reliance by growers on single mechanism



Varietal control – mean clubroot disease severity (% – December)



Kommando susceptible, Mendel and Cracker carry resistance

Yield by site t/ha



Kommando susceptible, Mendel and Cracker carry resistance

Prevalence and distribution of resistance breaking strains present in UK

SRUC

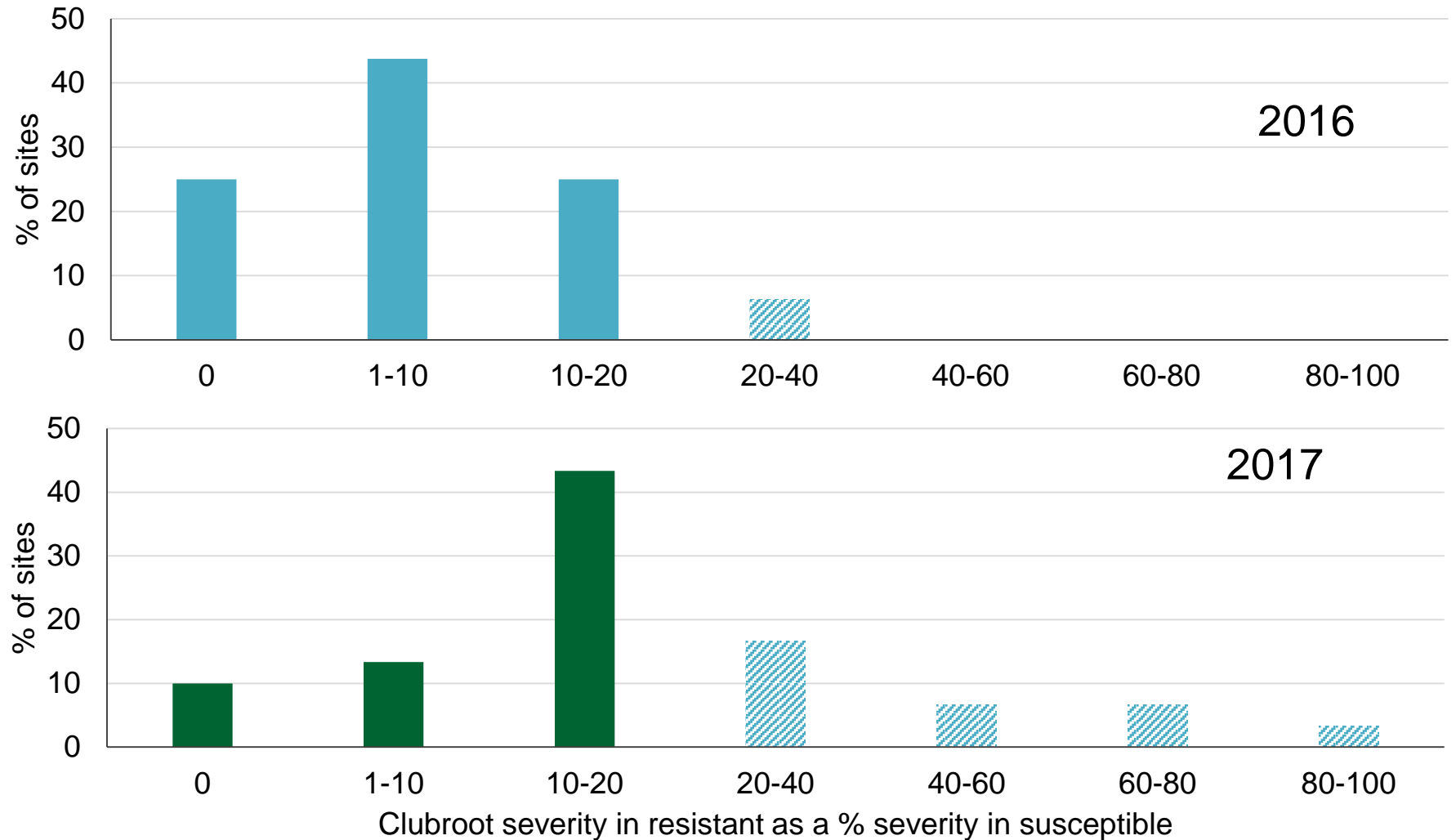
AHDB project RD-2140027105

- Soil sampled from 90 commercial clubroot infected fields across the UK
- Soils tested for presence/absence of Mendel virulence
- Soils tested for pH
- Sub-sample of 30 soils tested against ECD set for pathotype determination
- Soil and cropping details collected for each field



Mendel resistance breaking strains

– common throughout UK



Preliminary pathotyping (ECD)

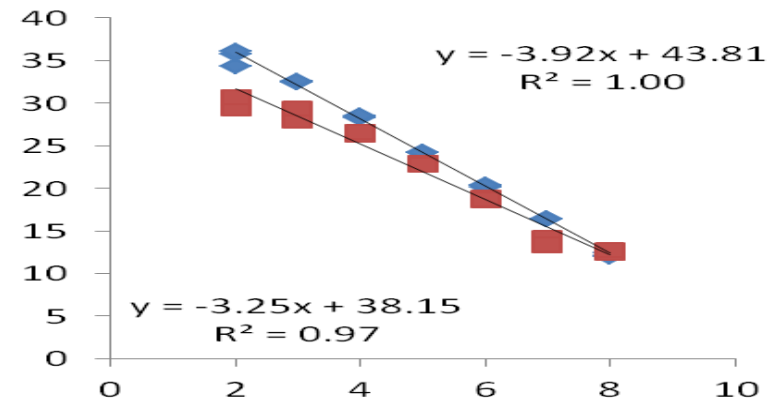
- shows that clubroot in the UK is highly diverse



2016 Field	Dominant pathotypes defined by ECD	2017 Field	Dominant pathotypes defined by ECD
1	16/02/30	11	16/31/31
2	16/26/04	12	17/31/30
3	16/15/31	13	16/15/30
4	20/31/31	14	*
5	17/31/31	15	19/31/30
6	16/31/31	16	17/31/30
7	17/31/31	17	20/15/30
8	23/31/31	18	17/31/30
9	17/31/30	19	17/31/30
10	23/31/31	20	0/6/0

Field testing

- Soil testing allows both short and long term planning
- Clean soil is a diminishing resource
- Some practices not sustainable
- More detailed field mapping could facilitate targeted application of available control measures



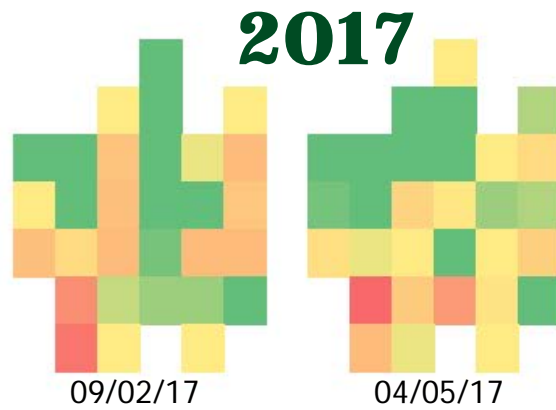
AHDB project RD-2140027105

Comparison of primers from [Faggian and Parsons \(2002\)](#) and [Wallenhammar et al. \(2012\)](#)

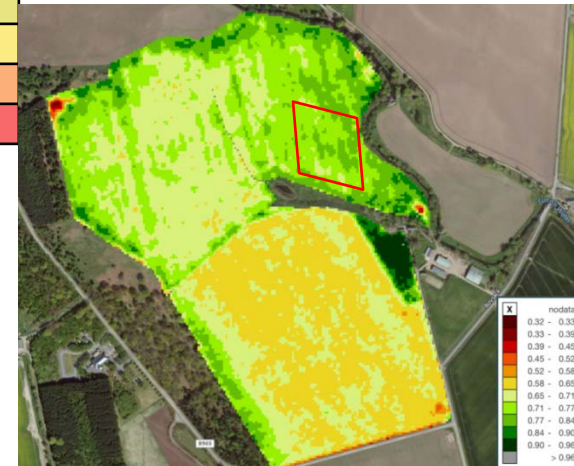
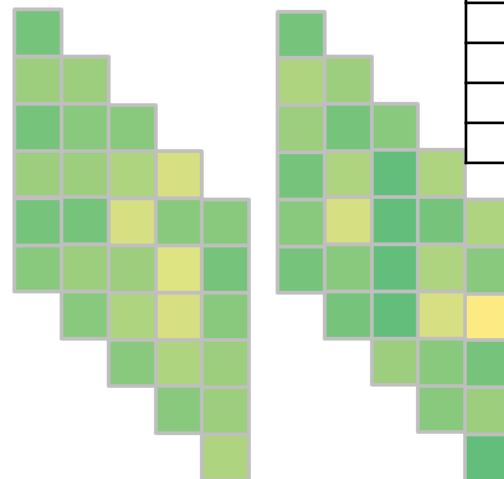
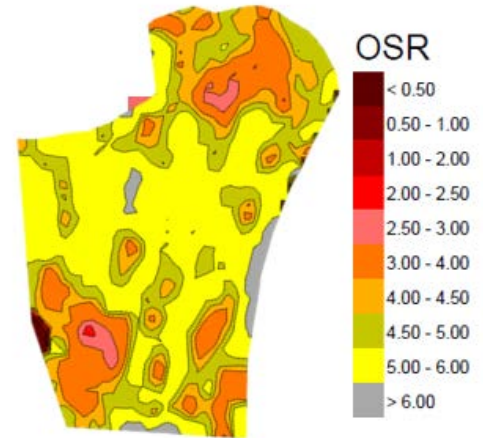
Field mapping using soil tests, UAVs and yield maps



Top: Little Dilwyn, England. Bottom: Backboath, Scotland



Clubroot severity (0-100 index)	Color
0	Dark Green
10	Green
20	Light Green
30	Yellow-Green
40	Yellow
60	Light Yellow
70	Yellow
80	Orange
90	Red-Orange
100	Red



Mapping can help to quantify economic losses and aid decision making



3.806	1.9236	1.748	3.806	
3.806	2.336	1.748	3.806	4.1
3.806	2.336	1.748	2.924	3.806
3.806	2.336	1.748	3.806	3.806
3.806	2.336	2.336	3.806	
3.806	2.336	2.924	3.806	
3.512	3.512	3.218	4.1	

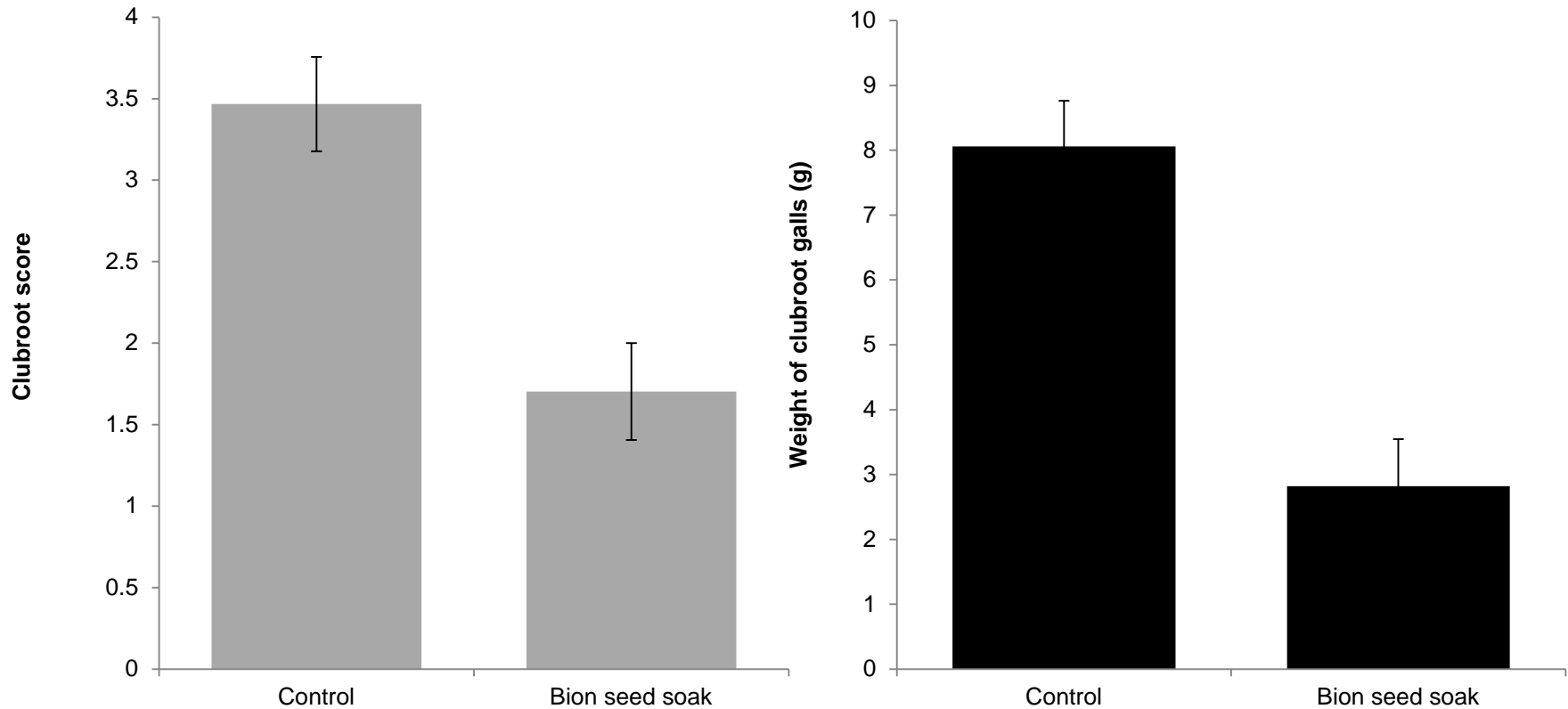
2016 Market field (t/ha)

3.7	3.7	3.7	3.406	3.406	3.7
3.406	3.406	3.7	3.406	3.406	3.112
3.406	3.406	3.7	3.406	3.7	3.7
	3.406	3.7	1.936	3.7	3.112
		3.112	3.112	2.818	3.406
				3.406	3.406

2016 Podge field (t/ha)

Novel control methods?

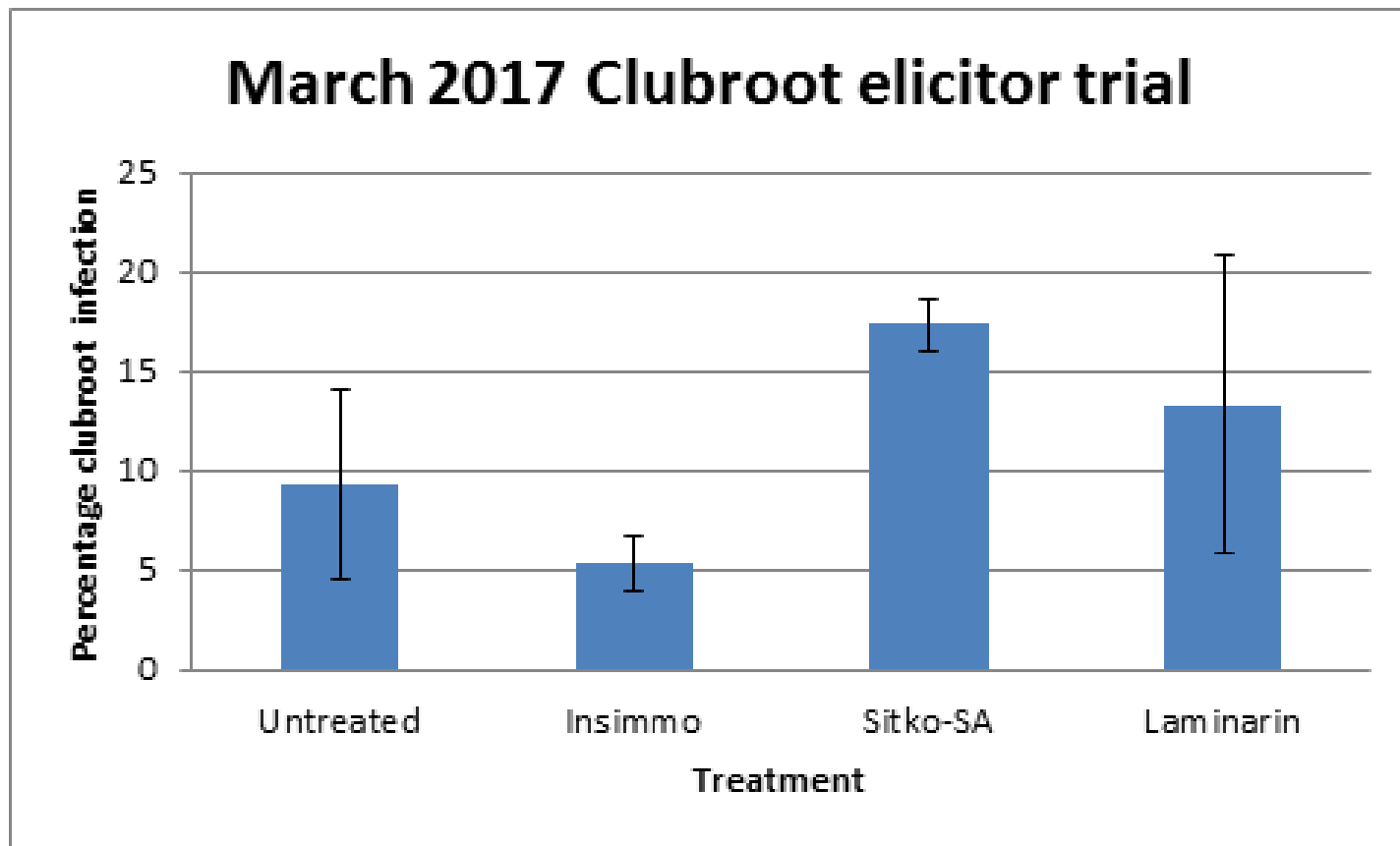
Elicitor application – seed soak



Replicated pot experiments following on from earlier work on soil drenches and foliar sprays

Field trials - seed soaks

– results show elicitors give variable control



Summary



- Soil amendments that raise soil pH and calcium content only partially reduce disease severity.
- Varietal resistance gives good control at many sites but is often poor at sites where resistant varieties have been commonly used in previous rotations
- Mendel breaking strains are present throughout the UK
- Alternative control measures such as elicitors have some potential
- Targeted application of such measures (through field mapping) might help

Current UK advice



- Test soils for clubroot and pH and use results to plan strategy for farm.
- Pay attention to hygiene and soil movement.
- Rotations of greater than 1 year in 5 are likely to be beneficial.
- Avoid early sowing on infected sites
- Avoid over-reliance on resistant varieties in short rotations
- Only deploy resistant varieties where justified by disease level to avoid over use and selection of virulent strains
- Maintain high pHs on infected sites and use long rotations.
- Spot treat infected patches in fields with lime

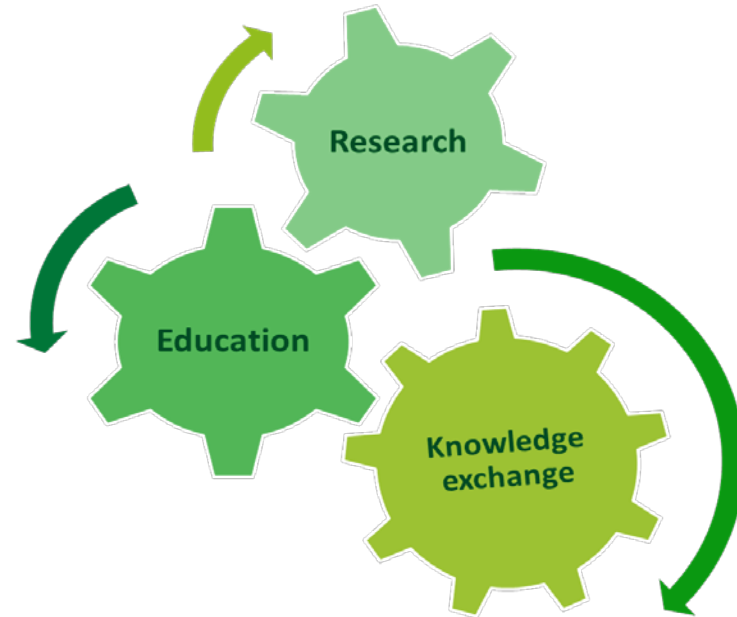
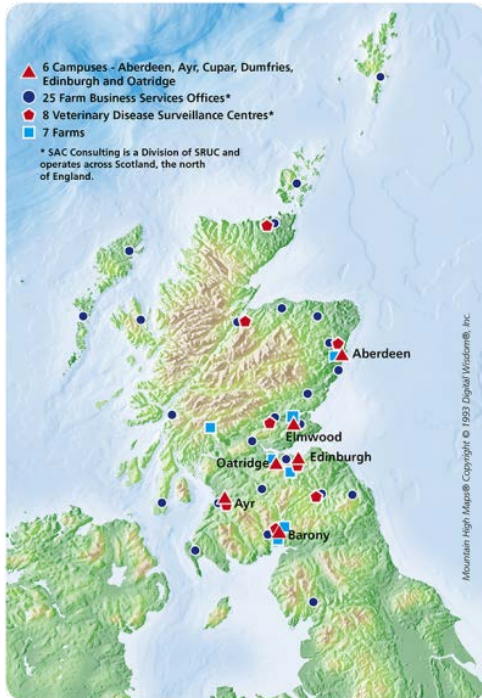
Future needs



- Improve methods for early (cheap) detection and prevention of clubroot
- Expand the range of tools for integrated and sustainable disease management (resistance, tolerance, escape, bio-control, elicitors)
- Develop robust economic models to deploy tools sustainably and to help industry resolve conflict between short term profitability and long term sustainability

Thank you!

Plus acknowledgements to staff teams at ADAS and SRUC



REF2014
Research Excellence Framework

Ranked #1 in the U
for Agriculture,
Veterinary and
Food Science



SRUC: Winner of the 2017
Queen's Anniversary Prize
for Higher and Further Education.