# WP 2.1
# Integrated Pest Management and pathology

## Linking to plant health policy

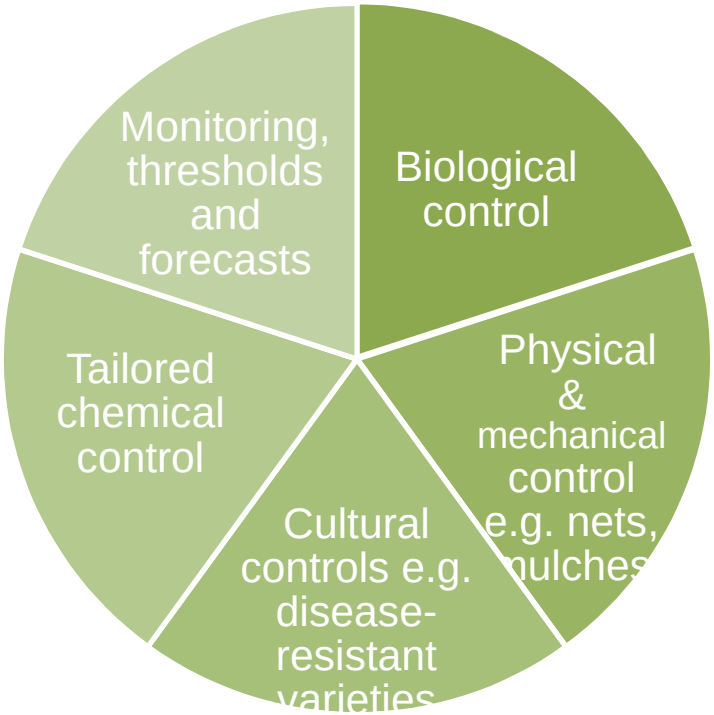
# Context for IPM

- High health status – statutory disease
- High endemic disease burden
- Limitations on chemistry
- Sustainable Use Directive, Water Framework Directive, PPP regulations
- Integrated Pest Management

# Fighting pests the clever way….

Integrated Pest Management (IPM) takes a whole farm approach to managing the land which:-

- Maximizes the efficiency of crop production
- Minimizes negative effects on the environment



# Research in WP2.1

- Assessing risk
- Better information
- Better decision making
- Efficacy and timings of interventions
- More interventions
- Integrated toolboxes

# What are the key components of integrated crop health?

- Protection and enhancement of important beneficial organisms
- Crop rotations
- Resistant varieties
- Cultural controls
- Healthy seed
- Monitoring/forecasting
- Thresholds and diagnostics
- Use of biological, physical and other non-chemical methods
- Understanding how pathogens reduce yield
- Targeted application of pesticides (optimised timings, best products
- Stewardship and anti-resistance strategies

# Highlights for today

- Co-construction and IPM planning tool
- Blight forecasting and decision making
- Cereal pathology and ramularia

# Is there capacity and willingness for IPM uptake in Scotland?

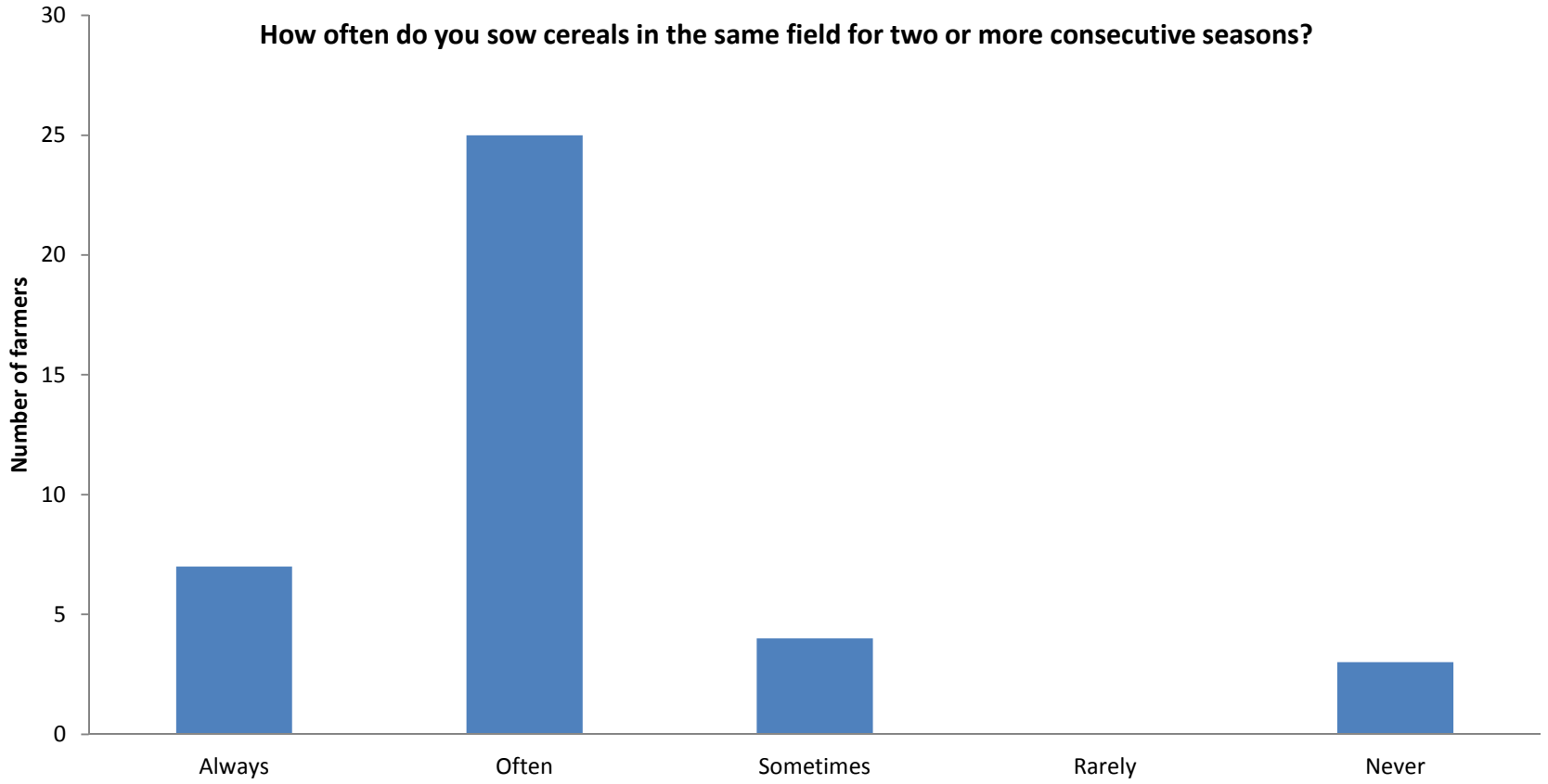
## Co-construction

Survey results SRUC / AHDB workshops -

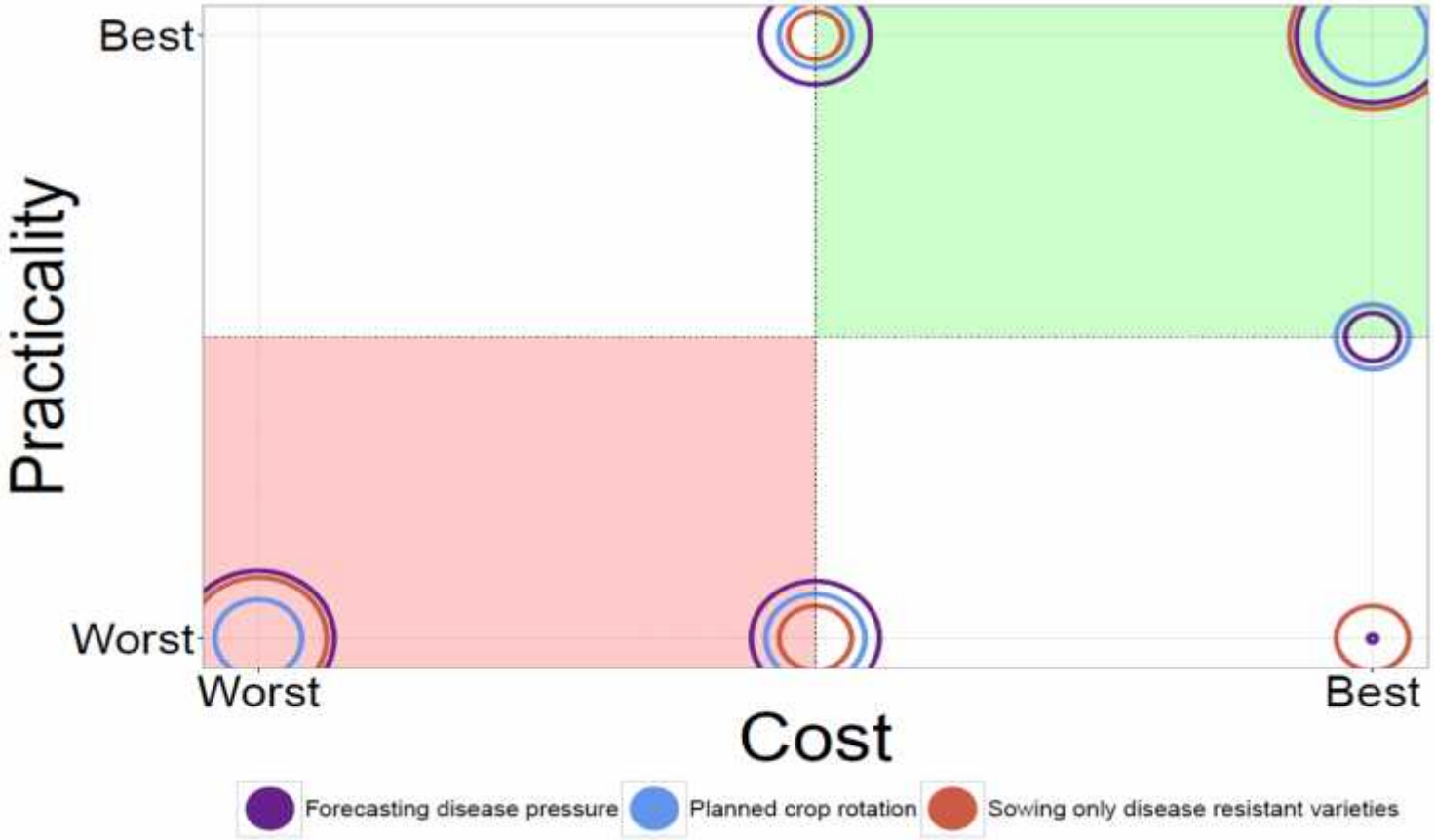
uptake of and attitudes to IPM measures for spring barley

- Despite farmer self-reporting that they often/always sow highly resistant varieties (60%) this was not actual practice for Rhynchosporium (23.1%) or Ramularia (27.3%)in 2011-15.

# Rotation practices less than ideal



# Farmer perceptions of IPM techniques are polarised




Best-Worst Scaling bubble plots in terms of cost and practicality of implementation

# Showing impact

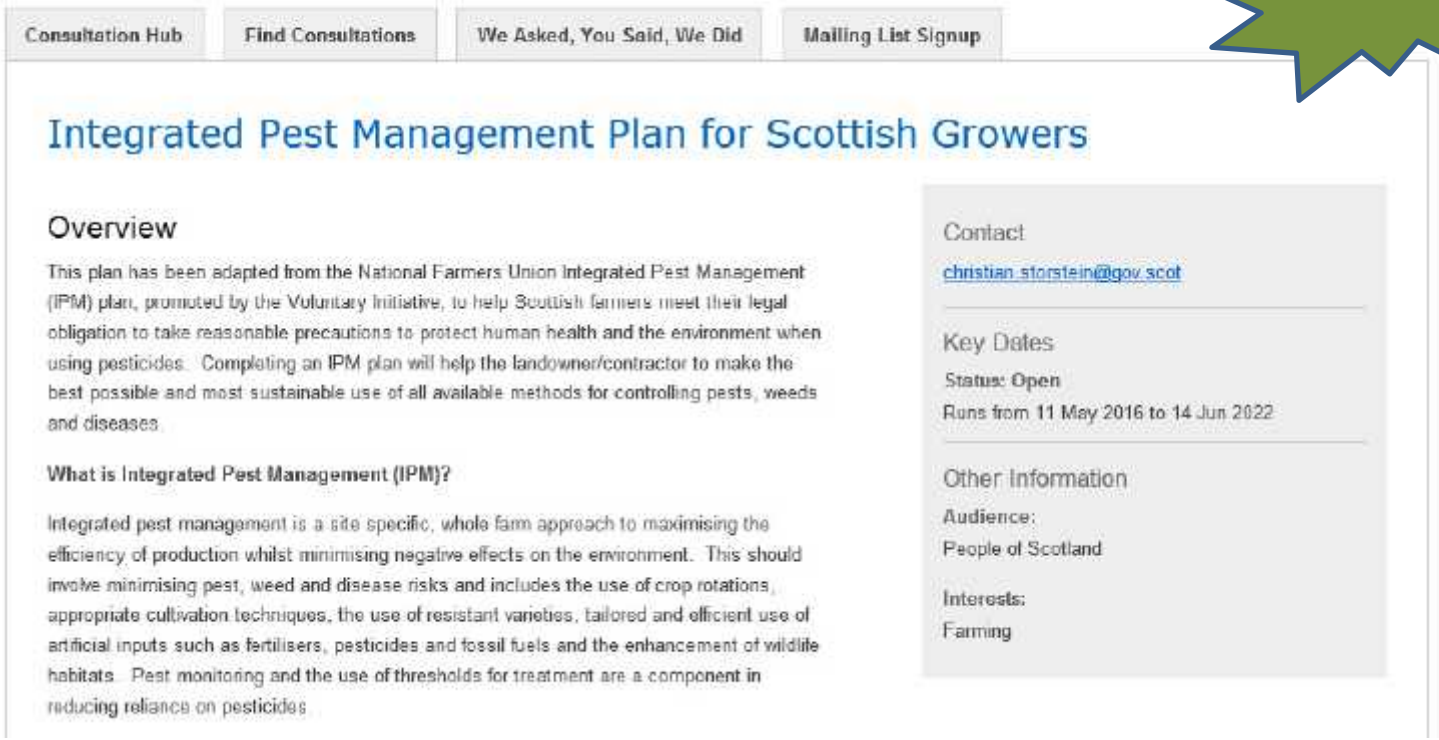
Sustainable Use Directive – land users strongly encouraged to have an IPM plan

# On-line planning IPM tool for Scotland

SEFARI

The Scottish Government

NEW




http://bit.ly.pestmanagementplan

# Scottish IPM plan asks for ….

- Background
- Pre-planning
- Identification of major risks
- Sustainable use of pesticides
- Use of monitoring and surveillance
- Further plans and additional reading

Takes around 15 minutes, you can view all the questions when you enter your email. Your data is protected and your email is only required so that your plan can be emailed to you.

# What are the benefits of completing an IPM plan?

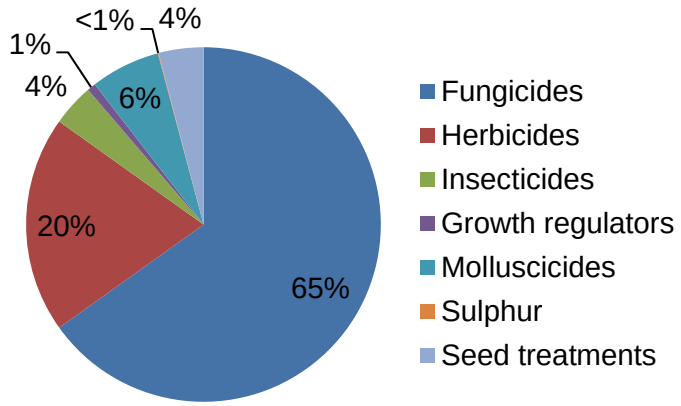
- Gives growers an idea of what is currently done on-farm that is considered to be IPM
- Helps them reduce reliance on pesticides
- Maximises the effectiveness of all crop protection methods
- Assists with long-term plans to reduce the pest burden on farm
- Lets them tailor annual inputs to the in-season risks
- Reduce waste and improve business practice and productivity
- Improves pesticide stewardship

- Shows promotion of IPM measures
- Informs pesticide survey data
- Gives metrics to track progress

# Late Blight research: influencing IPM decision making

# Potato late blight (*Phytophthora infestans*)

- ~ 28,000 Ha of potatoes planted in Scotland in 2016
- Estimated value of crop = £209M
- 98% of crops are treated with pesticide
  - 65% of pesticide = fungicide
  - 99% of fungicide use is to control late blight




Use of pesticides on ware potatoes - 2016
Source: Pesticide Usage in Scotland: Arable Crops and Potato Stores 2016

- Late blight destructive and economically important
- Rapid crop loss
- ~ 10-15 fungicide applications per season applied prophylactically (7-10d intervals)
- Cost of late blight control in UK ~ £72M p.a. in high pressure seasons

- Ideal target for IPM?

# Late Blight control – is there a problem ?

- Fungicides are effective if applied correctly
- Routine applications are convenient
- Fungicide insensitivity is relatively rare
- Anti-resistance recommendations are in place – FRAG-UK
- Active ingredients are available
- Costs are high, but risk is higher

# Risks and IPM opportunities

## Risks

- New fungicide insensitive genotypes
- Increasingly aggressive genotypes of *P. infestans*
- Fewer actives approved
- Loss of current actives
- More blight conducive weather

## Opportunities

- Meeting IPM targets
- Reducing economic and environmental costs
- Reducing reliance on pesticides

## Approach to late blight IPM

- Recognising the solutions
- Integration of knowledge
- Assessment and demonstration

# Research to recognise IPM solutions

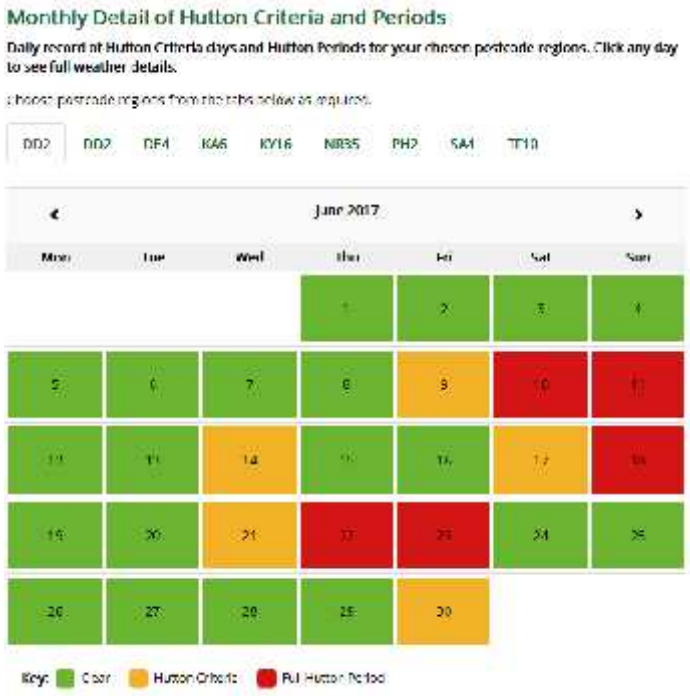
- Identification and effective deployment of host resistance is key
- Linking genotype and phenotype - understanding the implications of population changes in *P. infestans* for disease control (e.g. fungicide insensitivity)
- Forecasting disease outbreaks through modelling and forecasting
- Trialling and assessing IPM approaches in collaboration with stakeholders

# Improving late blight forecasting

New risk criteria which aim to transform the performance of potato late blight alert systems were launched.

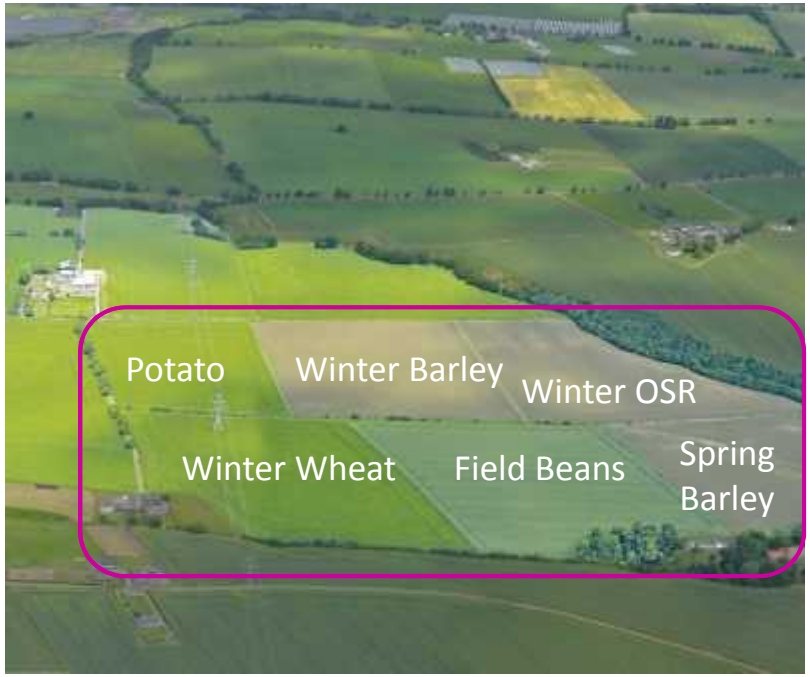
The ‘Hutton Criteria’ are a significant advancement on the current method for predicting blight pressure.

Used to inform growers of risk conditions in 2017



Hutton criteria (Blightwatch alerts) used to inform ‘sustainable’ fungicide strategy 2017 with aim of better targeting fungicide applications

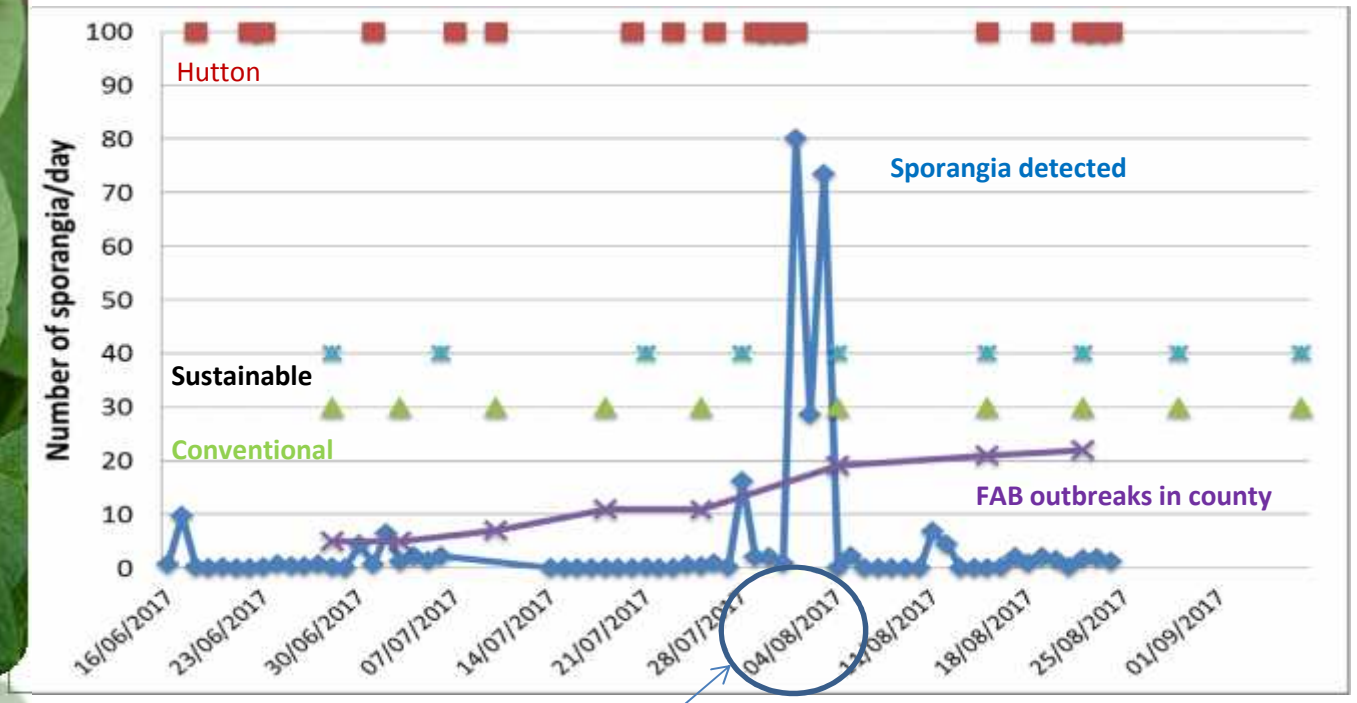
Hutton CSC long-term rotation




| ‘Conventional’ | | | ‘Sustainable ’ | | |
|---|---|---|---|---|---|
| Maris Piper (FB rating = 4) | Vales Sovereign (FB rating = 5) | Mayan Gold (FB rating = 7) | Maris Piper | Vales Sovereign | Mayan Gold |

Conventional = robust 7 day fungicide programme starting on a set date
Sustainable = robust programme triggered only by Blightwatch (Hutton period)

Bringing together information on host resistance, knowledge of the pathogen population, presence of inoculum, Hutton criteria and national outbreak data to inform and test an IPM approach to blight control

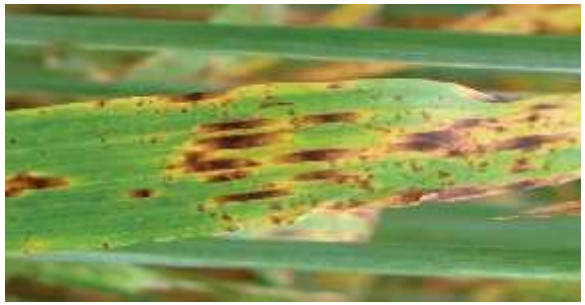



1st blight observed in DD2 postcode in untreated plot

# Pathology highlight:- research into ramularia

Barley  is the largest crop in Scotland and second in the UK with a market value of over £1 Billion

Ramularia causes losses ~£10 Million

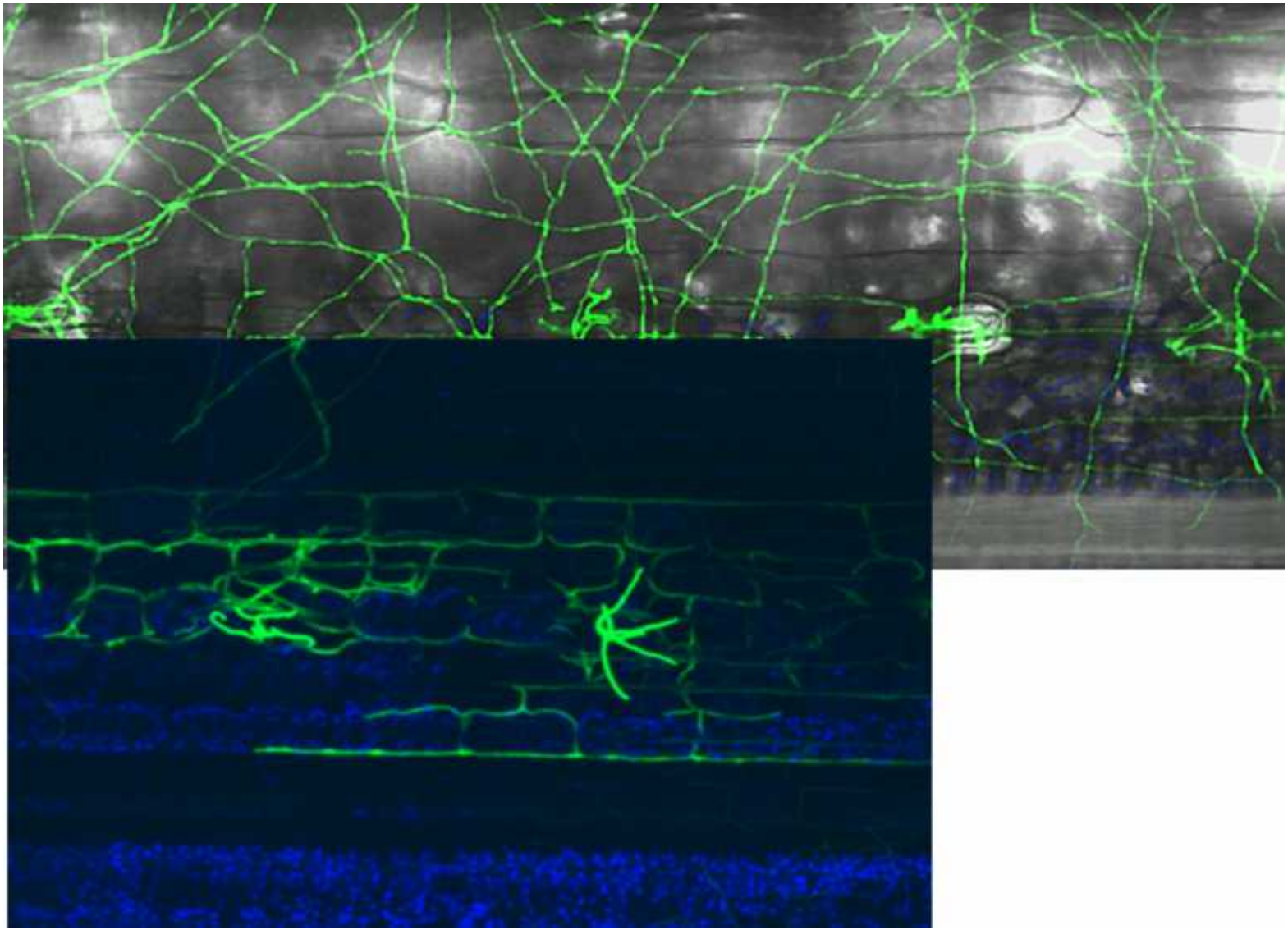


# Ramularia

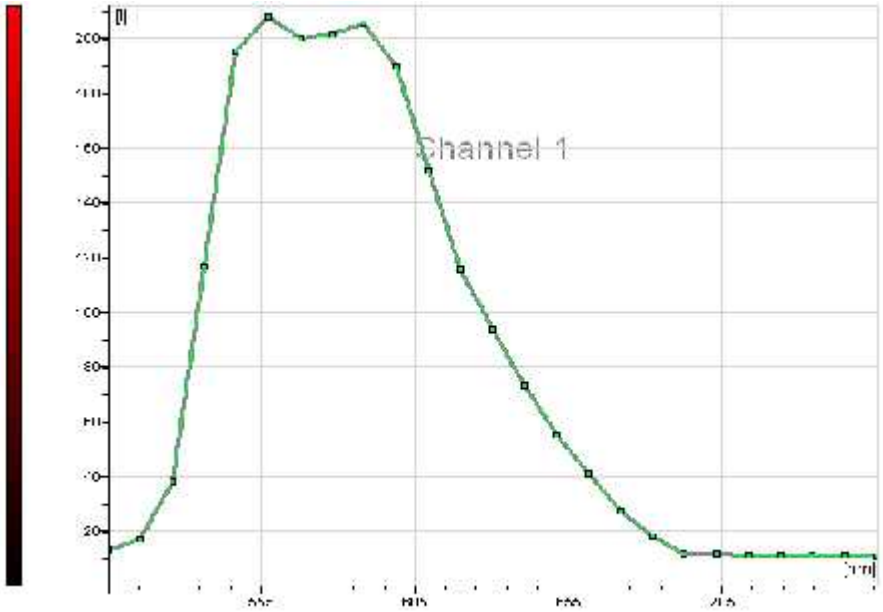
- All varieties currently susceptible
- Control reliant on fungicides
- Current and historical efficacy and resistance status of fungicides
- 4 ‘R’s for diagnosis (ID guide in production)

# Ramularia leaf spot – in pictures

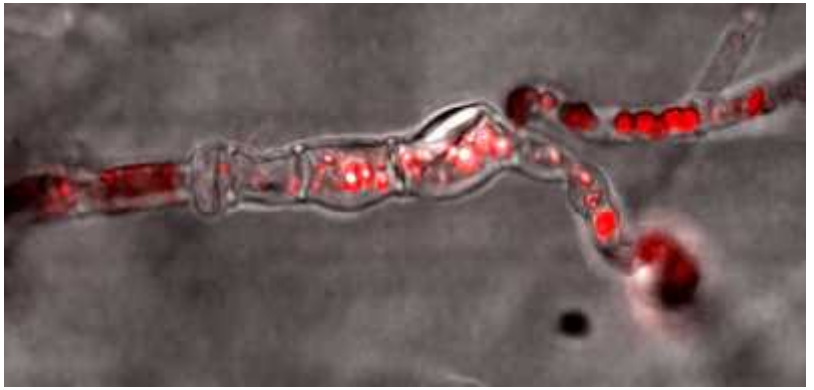
# Growing under the plant's radar

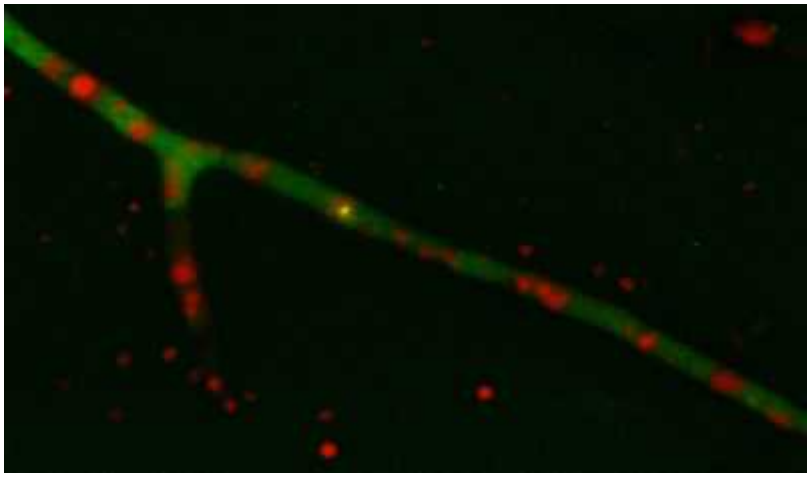


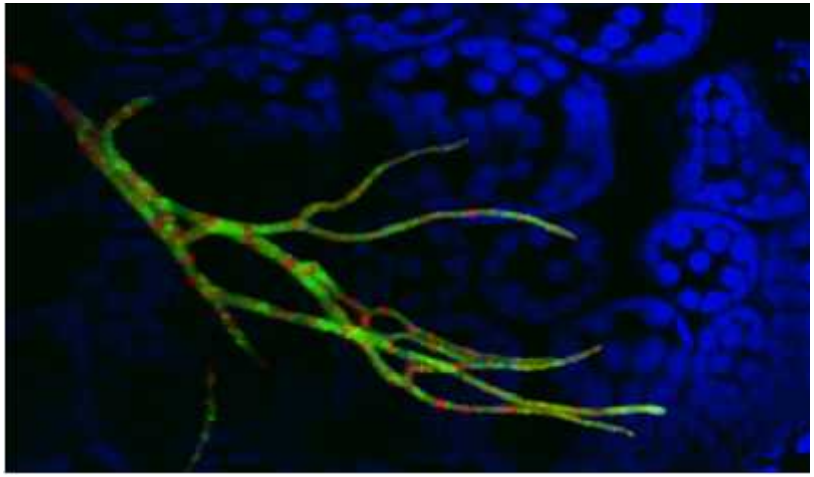
# Imaging of rubellin *in planta*



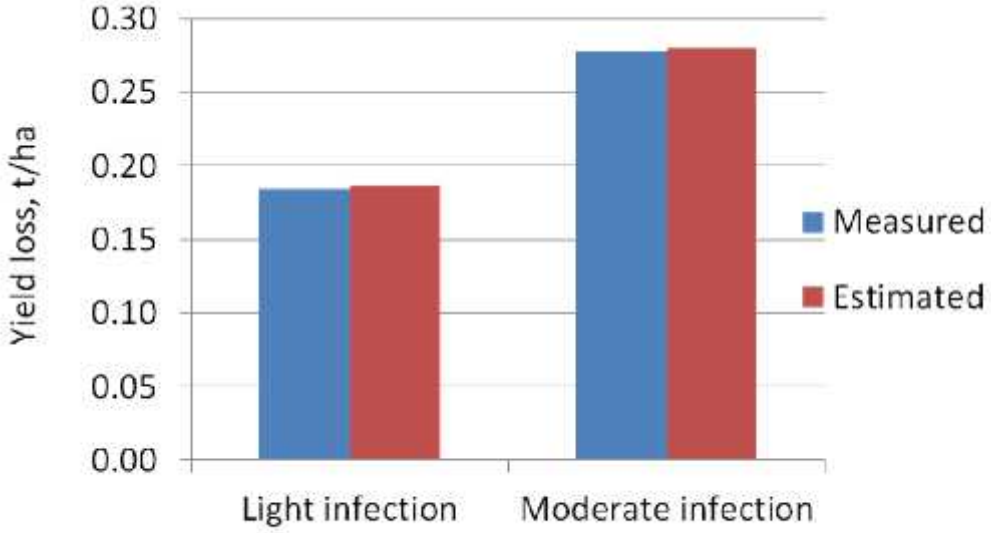

Fluorescence emission spectrum determined by spectral analysis
(lambda scan)







# Understanding what we are protecting




- Yield loss results from loss of photosynthetic green area by symptom expression, not asymptomatic infection
- Control and resistance breeding must focus on preventing symptom development

GS0 Ramularia seed-borne

GS 10-13 Ramularia detectable by diagnostics but no visual symptoms

GS25-30 Ramularia spots on dying leaves

GS25-30 Fungicides can reduce later disease epidemic

**Correlation between leaf wetness and symptom development**

**Second structure on straw**

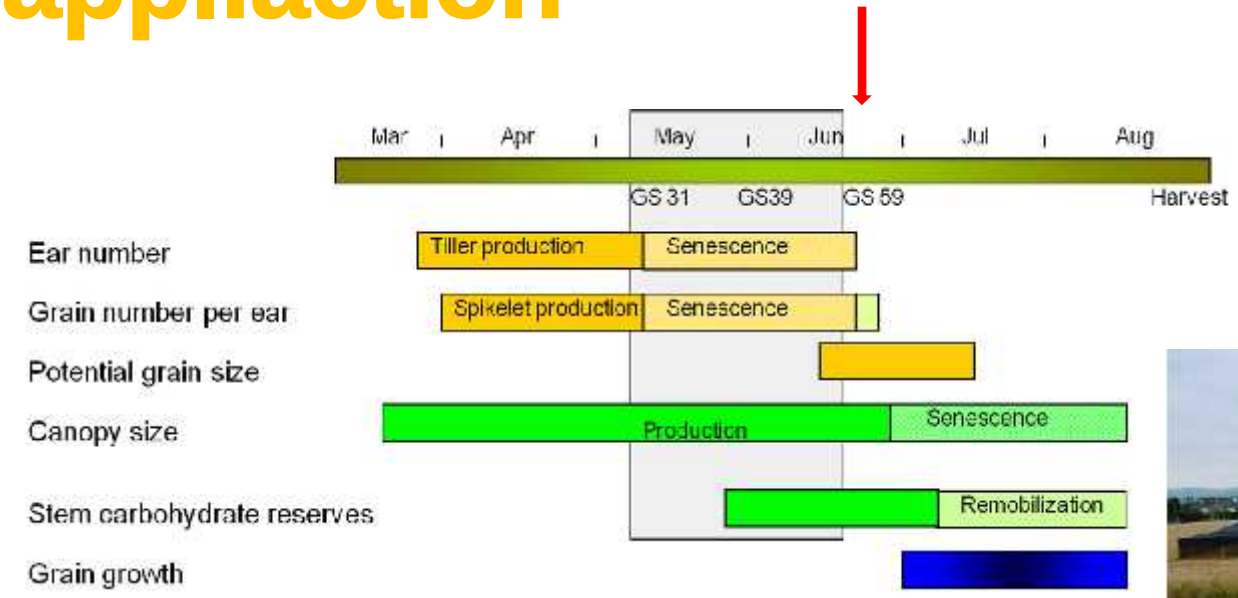
Airborne spores

GS45-49 Protect crops with fungicide

GS75-83 Ramularia symptoms on heads and awns

GS65 Fungus detected inside leaves 2-4 weeks before symptoms

# Advice on targetting appliaction




- Spring barley yield is sink-limited
- Early season protection is important to maximise the number of grains formed and their storage capacity
- Protection of the canopy after flowering is required only for the first 75-80% of grain filling

# Ramularia – evolving picture

- QoI resistance since 2002
- MBC resistance (2 forms)
- Emerging issue with SDHIs

- 2014 single isolates with slightly decreased sensitivity were detected
- 2016 Intimation of shift to SDHI and azoles in trials UK, DE, BE
- 2017 Control failure in 2017 trials

# Before and after…

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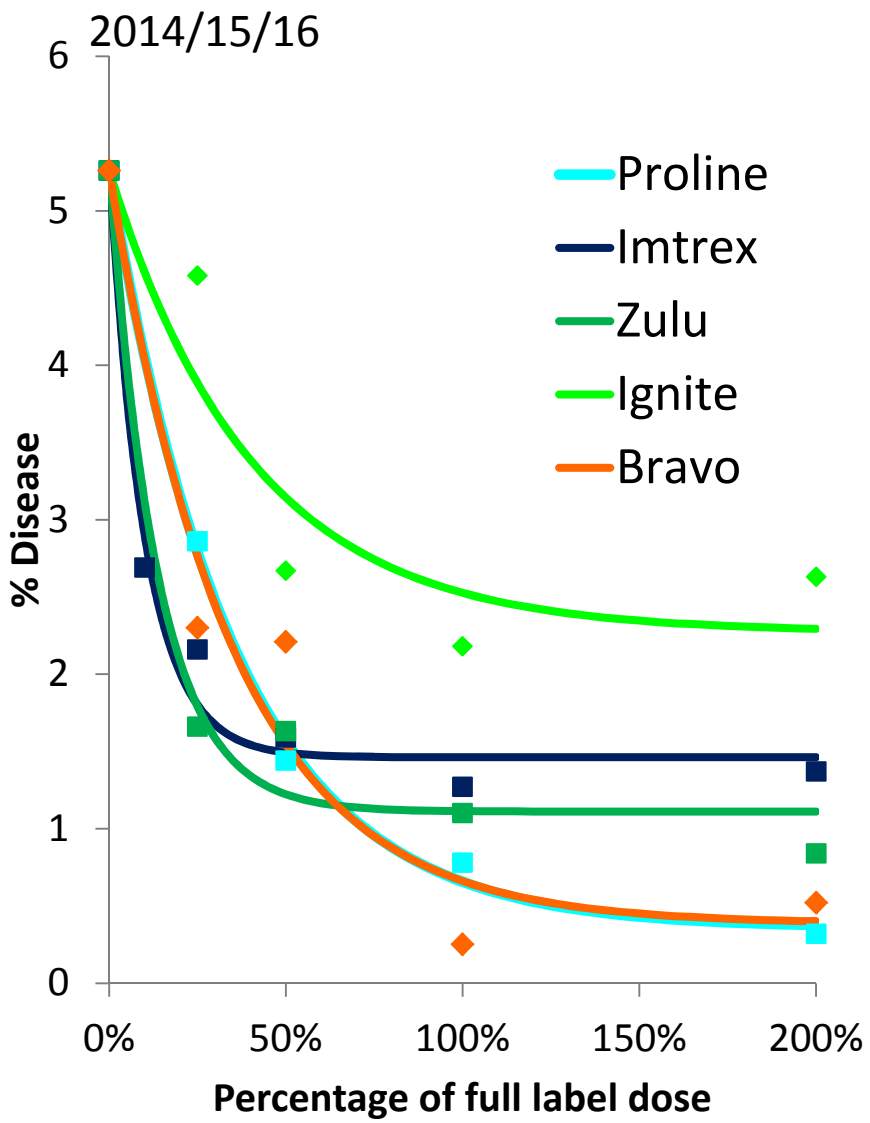


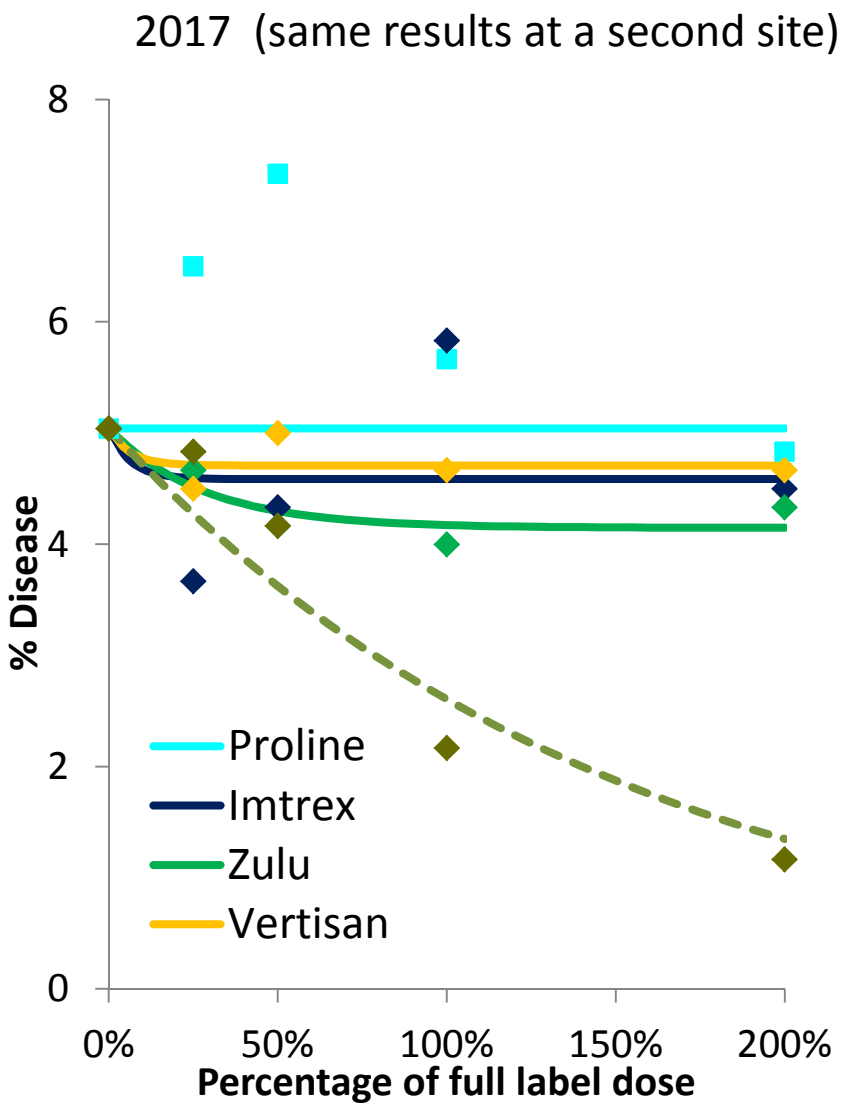

# Can we stop the wheels coming off?

- Very little new chemistry on the horizon
- Legislative threats to existing chemistry
- Stewardship advice has been more important than ever
- Informed CRD in terms of registrations, label recommendationas
- Advice to industry key

# Anti resistance strategies

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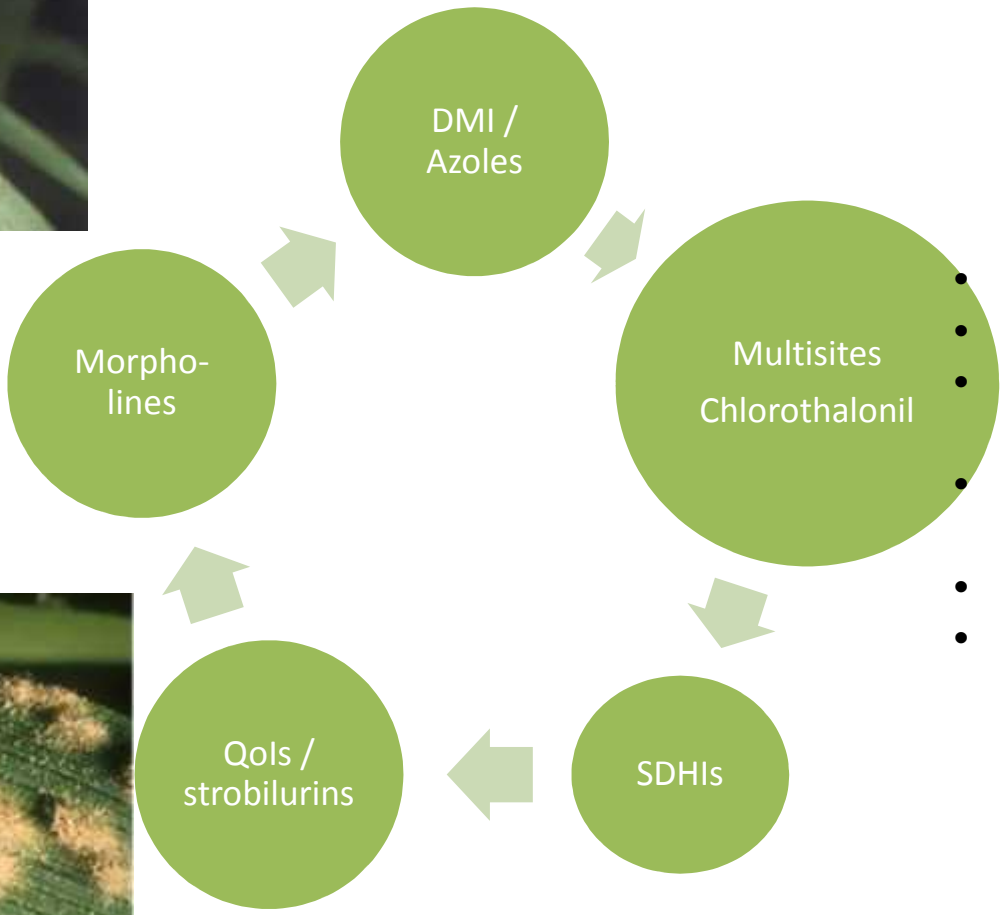
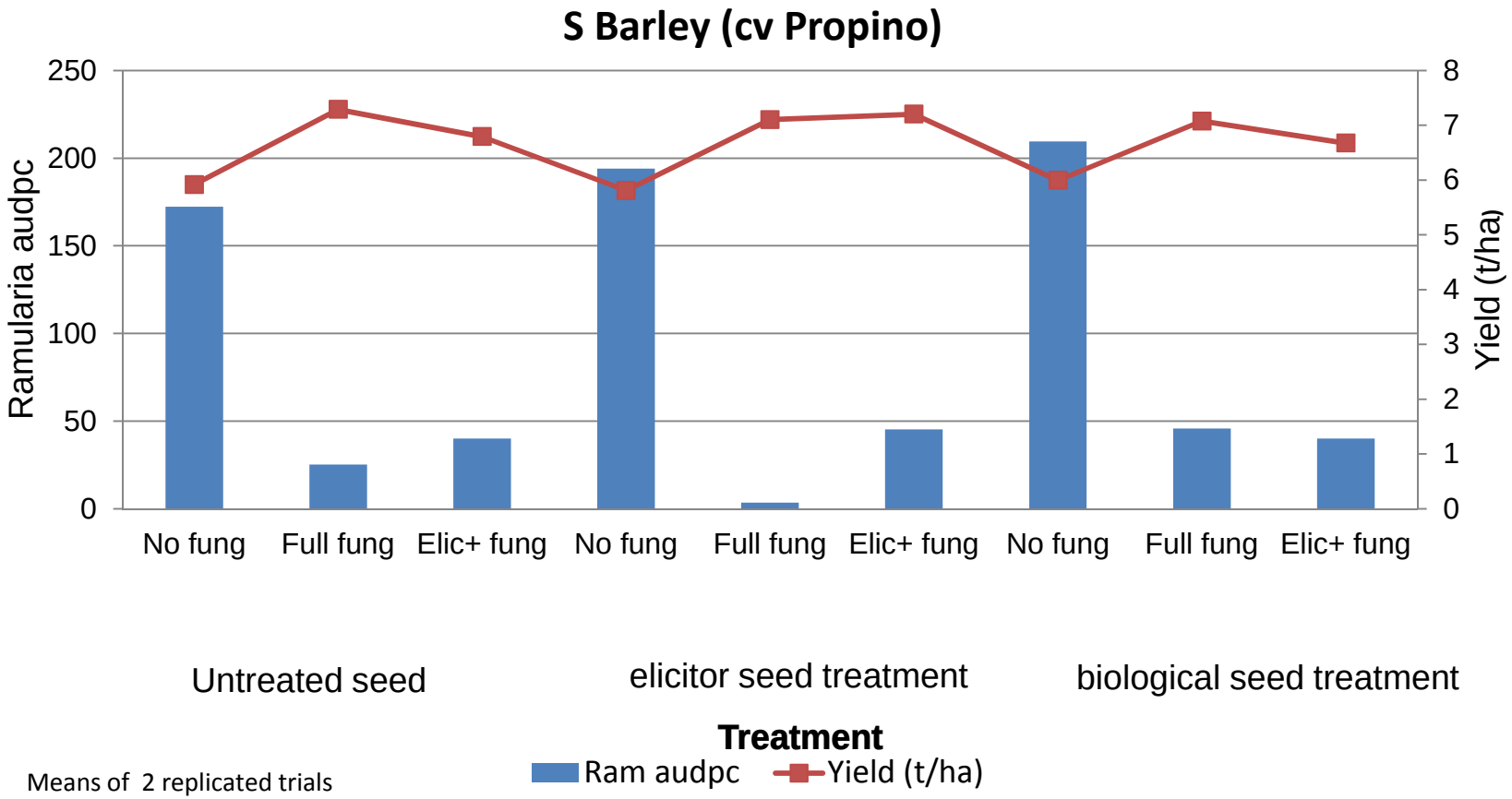
FRAG - UK




- Mix
- Alternate
- Minimise use of high risk actives
- Minimise number of applications
- Minimise dose
- Use alternative IPM measures

# Integrated disease control – new tools

Trials evaluating programmes which combine elicitors with reduced rate fungicides are showing potential




Means of 2 replicated trials

# Delivering practical messages

- Varietal choice – winter barley ratings added to RL this year
- Advice on tailoring inputs to risk and timing and on the most effective actives
- Guides and advice on resistance management and stewardship and advice to regulators on statutory limitations
- Key information on ramularia shifts shared with stakeholders (reliance on multisite)

# Incremental improvements being delivered

- Best producers aren't doing any particular thing differently
- Attention to detail and many seemingly small things add up
- New tools and integrated, tailored approaches are win:wins

# Collective Name For…

SEFARI


The James Hutton Institute

Moredun Research Institute

The Rowett Institute

SRUC

Royal Botanic Garden Edinburgh

# Thanks

SEFARI

Scottish Government
Riaghaltas na h-Alba
gov.scot