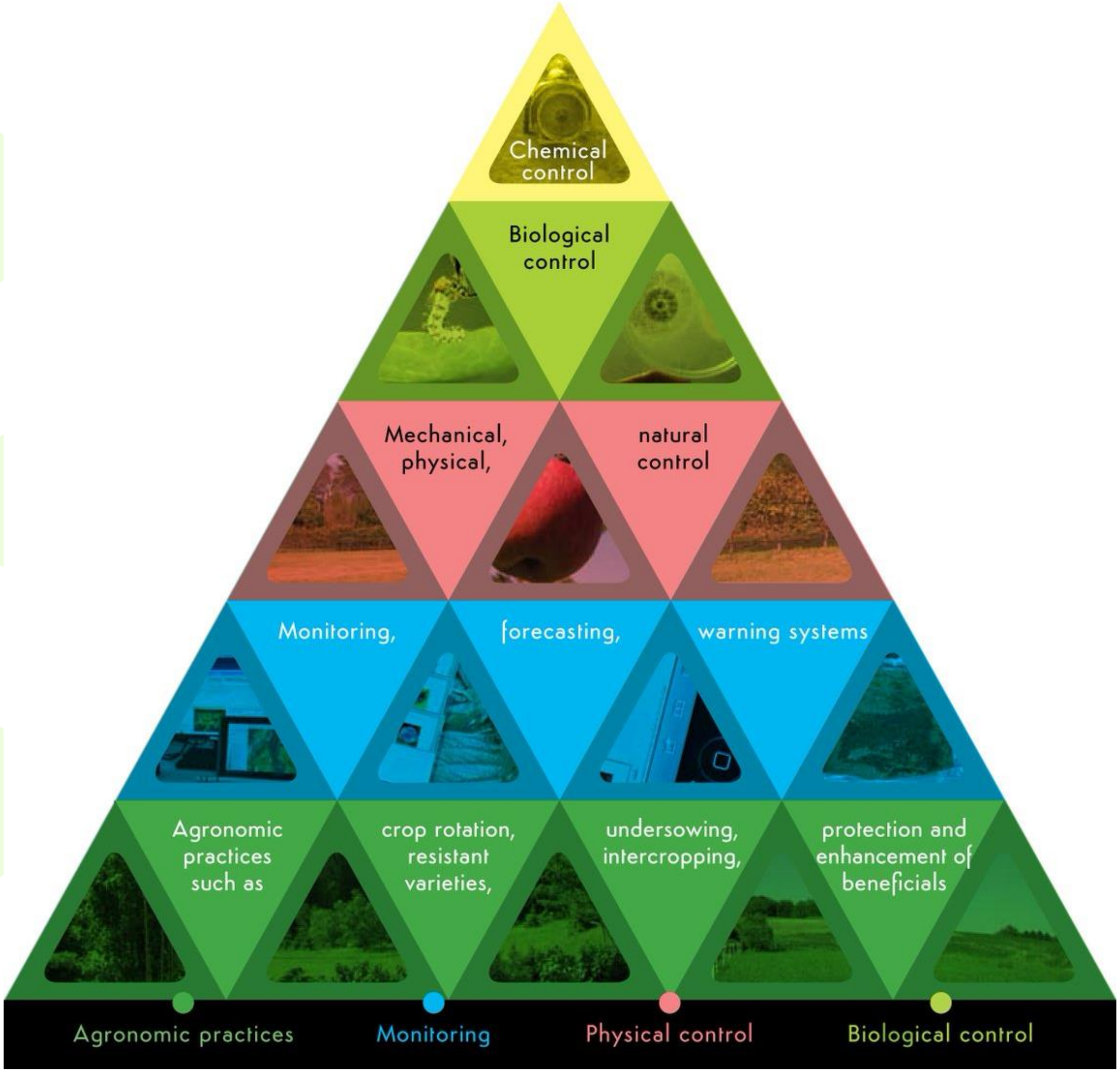
Integrating resistance elicitors into evolving crop protection programmes

Dr Neil Havis

IPM (or more accurately ICM)



What are elicitors derived from natural products ?

- Products derived from plant or other natural material.
- Antifungal proteins have been characterised from many plant species
- Many plant products also initiate the defence mechanism in crop plants

Ascophylum nodosum

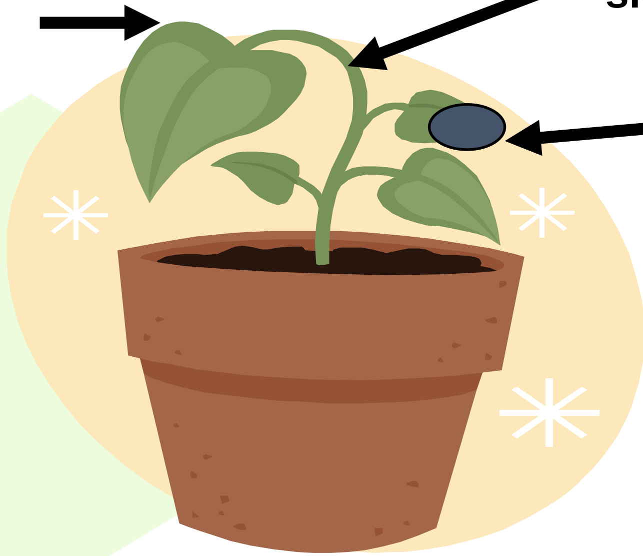
Priming for resistance
Systemic Acquired Resistance (SAR)

accumulation of:

- **salicylic acid**
- PR proteins e.g. PR-1

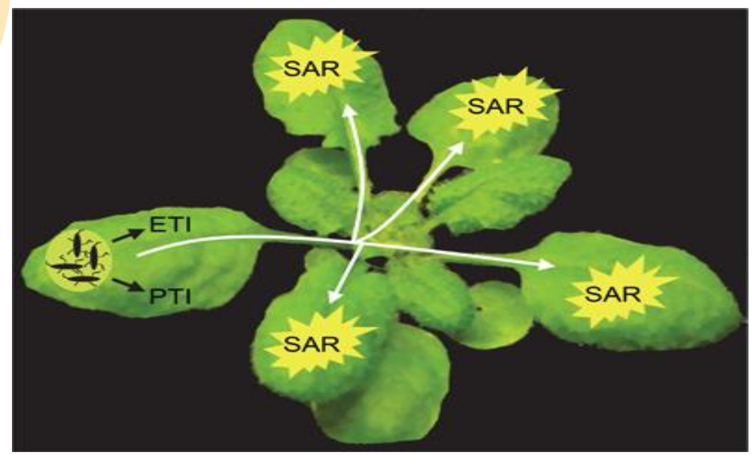
enhanced resistance to further infection

[**broad spectrum**]



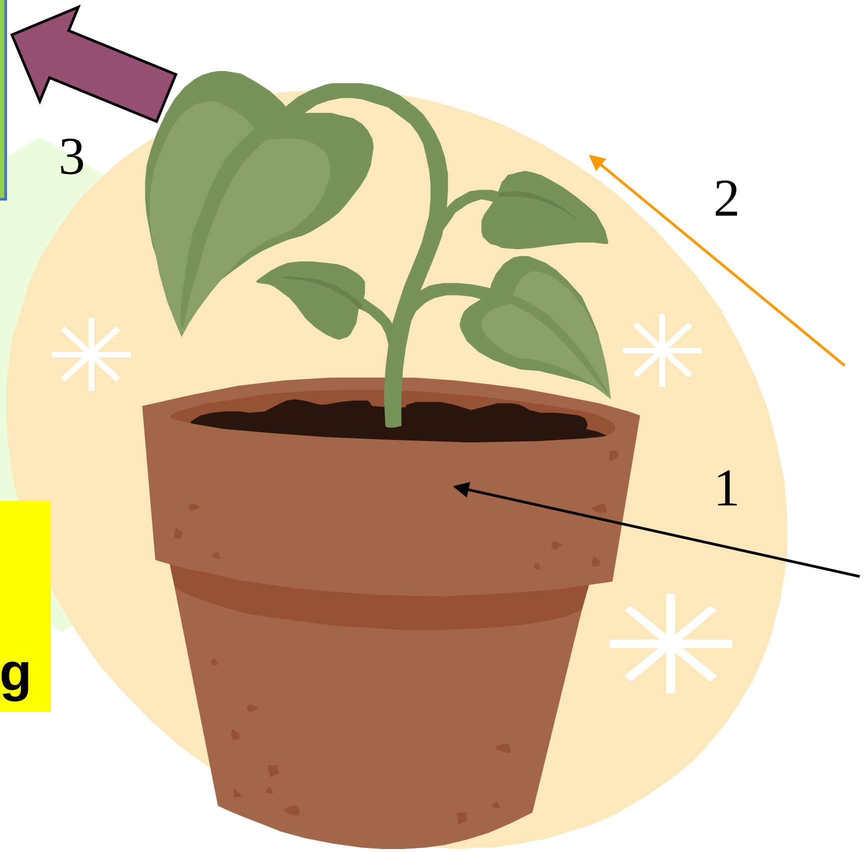
systemic movement of signal

infection by necrotizing Pathogen, biotroph or application of elicitor



Induced Systemic Resistance (ISR)

enhanced resistance to pathogen infection



movement of systemic signal

colonisation of roots by PGPR

dependent on jasmonic acid/ ethylene signalling

Range of 'elicitors' capable of inducing resistance

Agents or compounds that

- mimic action of natural elicitors e.g. Chitosan
- generate natural elicitors e.g. phosphate, phosphites
- mimic action of signals e.g. acibenzolar-s-methyl (BION/Innimisso)
- pathogens - prior infection (role for biologicals)
- mycorrhizal infection

Early work - Elicitors from fungal cell walls

SC6

SC3

SC1

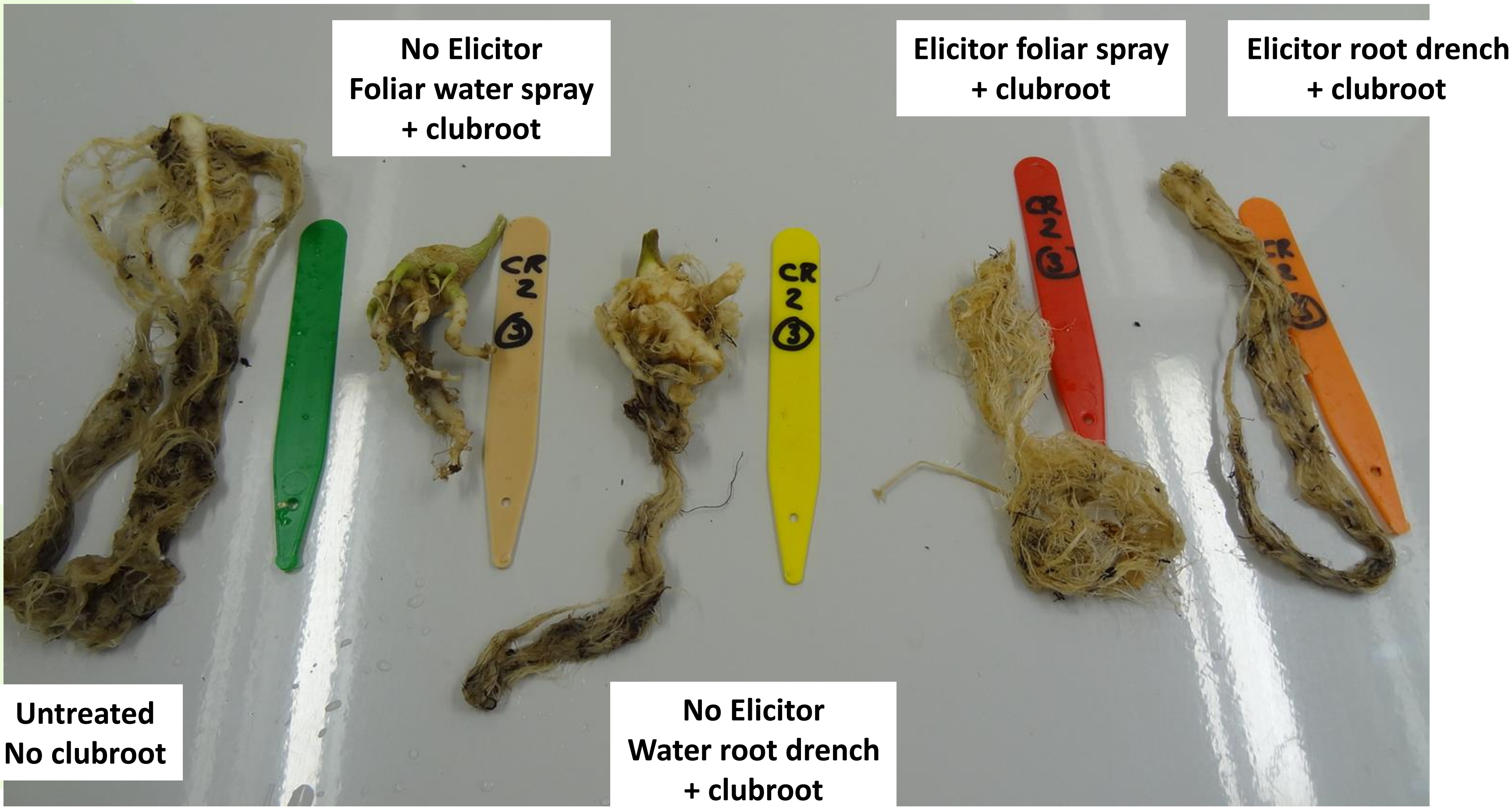
Control

Elicitors from yeast

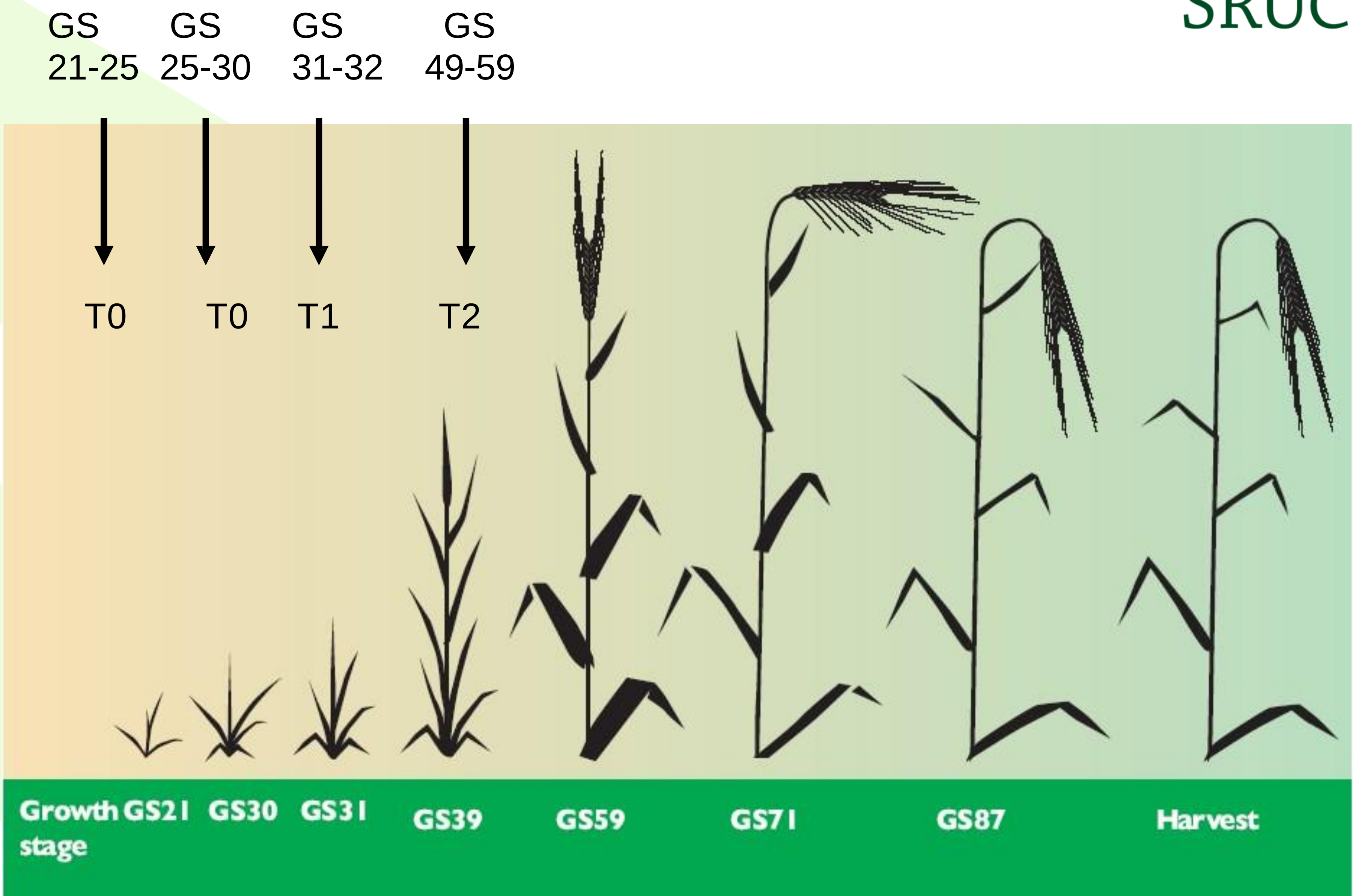
All elicit PAL activity and increase speed and size of papilla formation

From work conducted At JHI by Gary Lyon and Adrian Newton

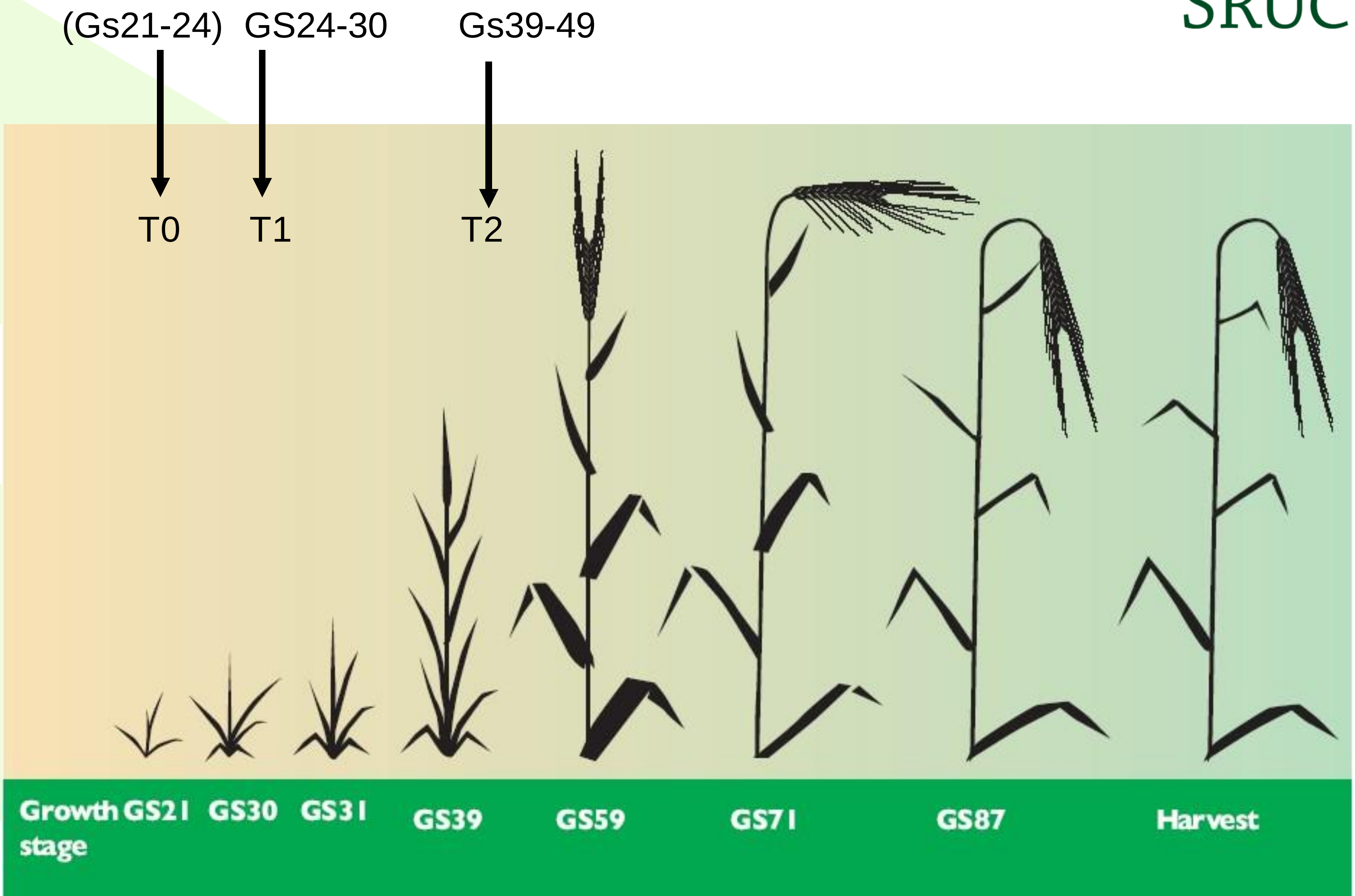
Renewed interest - Elicitor (Bion) effect on clubroot galling



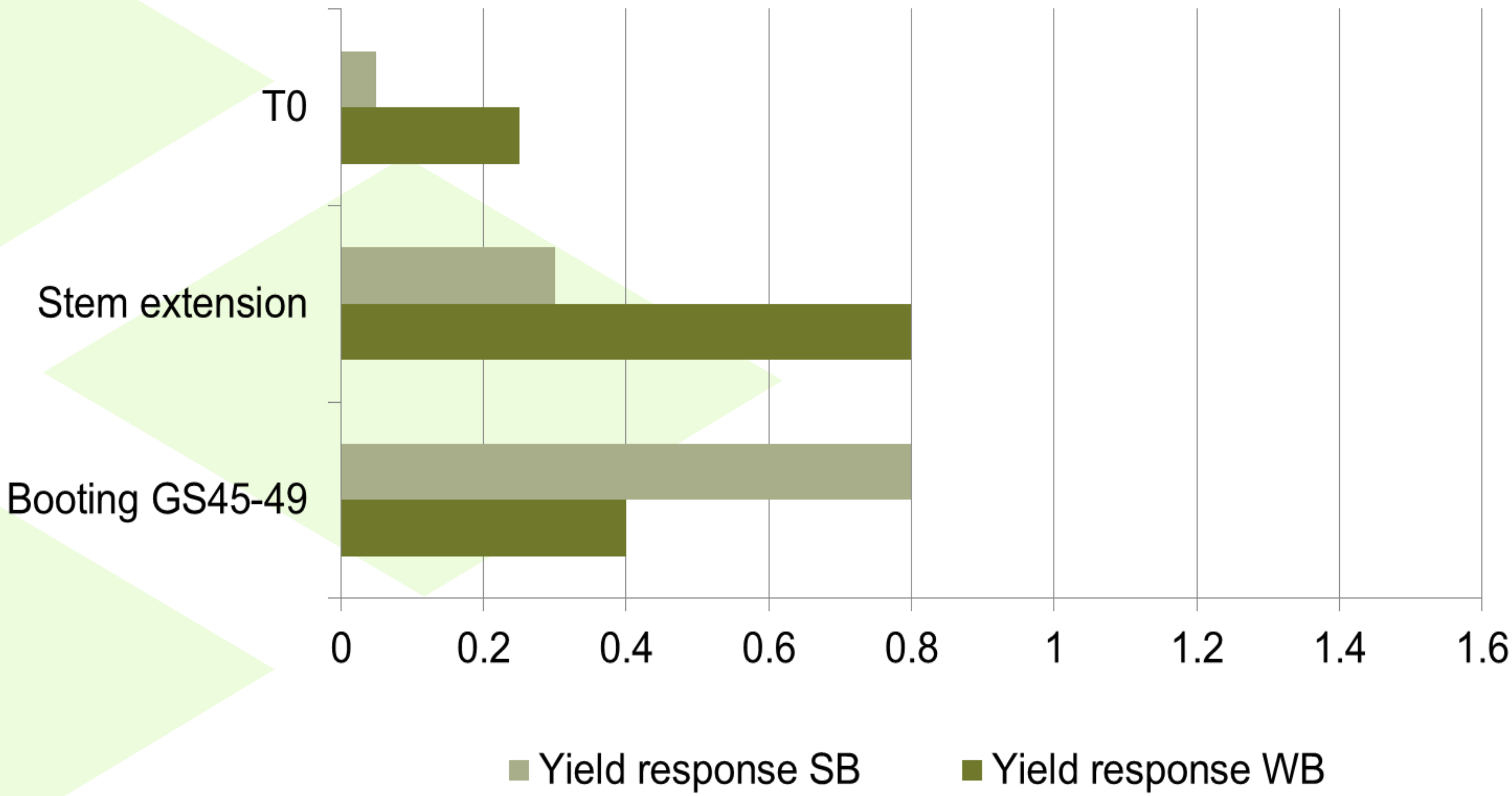
Winter barley



Spring barley



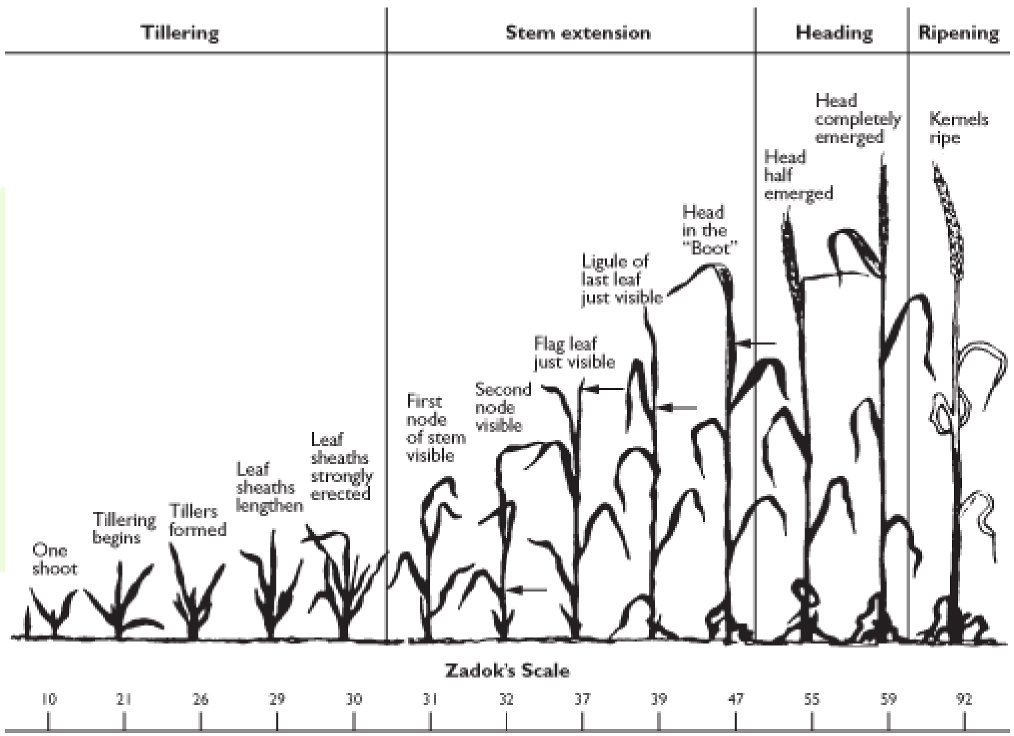
Yield responses to fungicides



Using elicitors and fungicides

Fungicide =
GS31
prothioconazole +
cyprodinil +
picoxystrobin

GS39
prothioconazole +
chlorothalonil

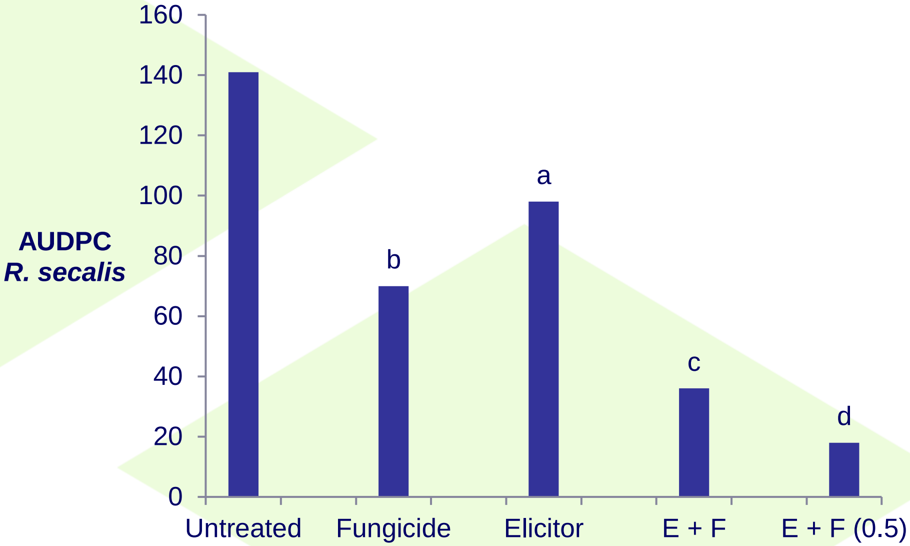


Elicitor =
cis-jasmone +
BABA + ASM

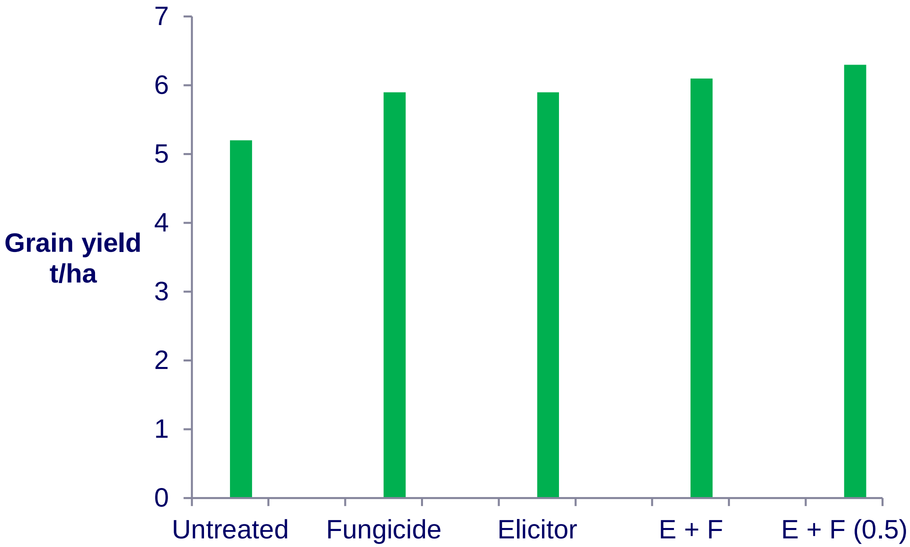
Elicitor GS24

Fungicide GS31 + GS39

Elicitors and fungicides – field experiments 2008



Spring barley variety = Optic



Best control achieved using elicitor + fungicide combinations

Evaluating seed treatment options

- A range of elicitors and biologicals were compared to conventional seed treatments over 2 seasons.

- Untreated
- Raxil seed treatment
- Regalia ®
- Biological 1
- Laminarin
- Companion (*Bacillus subtilis* GB03)

- Winter and spring barley trials scored for disease and taken to yield

Elicitors in trial

SRUC

Brown seaweed (*Laminaria* species)

Giant knotweed, *(Reynoutria sachalinensis)*

Foliar treatments – seed treatment comparison

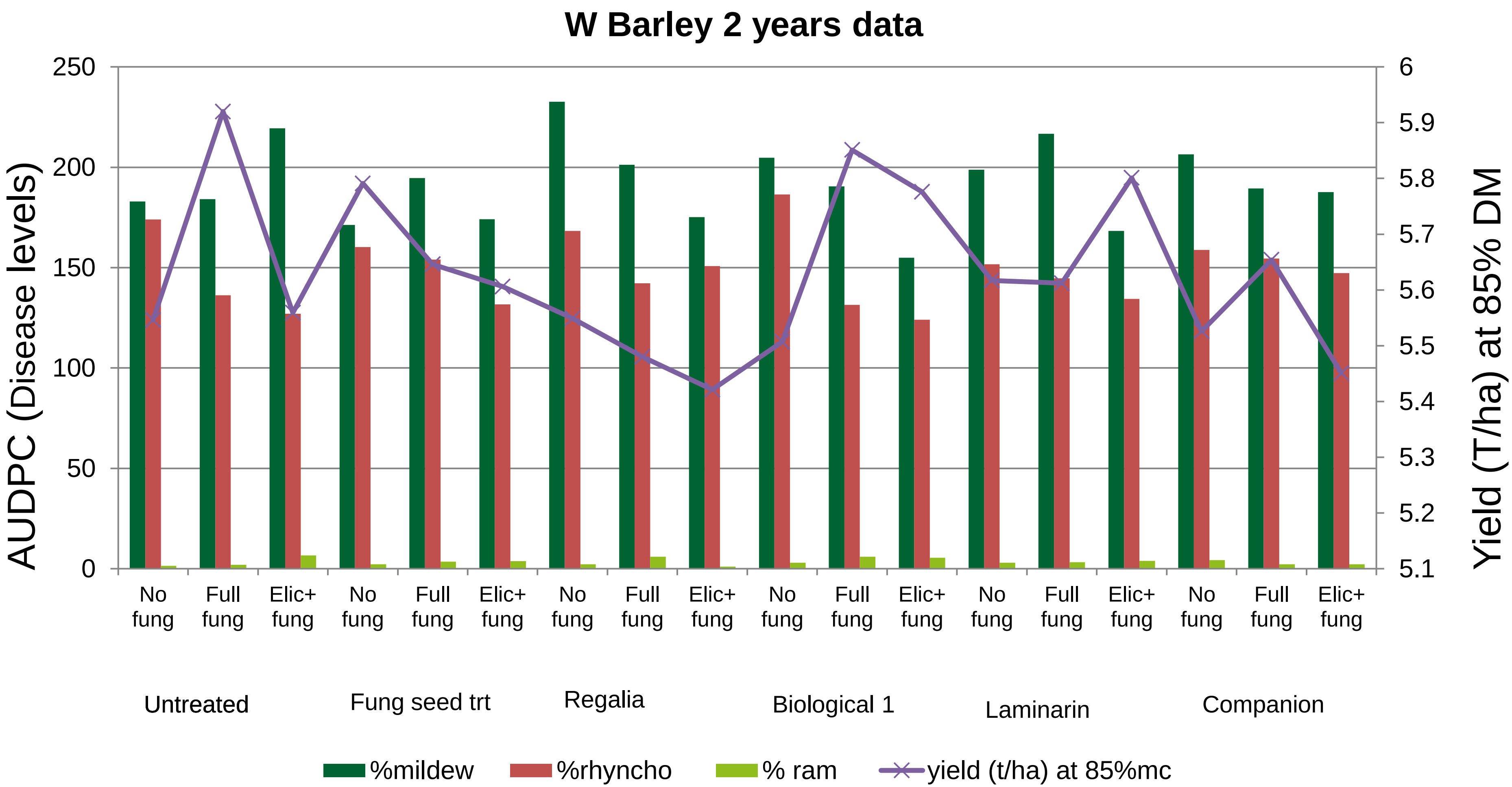
T0 GS 24	T1 GS 31	T2 GS 53
Untreated	Untreated	Untreated
Untreated	SiltraXpro 0.5l/ha + Comet 0.5l/ha	Proline 0.4l/ha + Bravo 1.0l/ha
Regalia 2.5l/ha	SiltraXpro 0.25l/ha + Comet 0.25l/ha	Proline 0.25l/ha +Bravo 0.5l/ha






Major disease threats

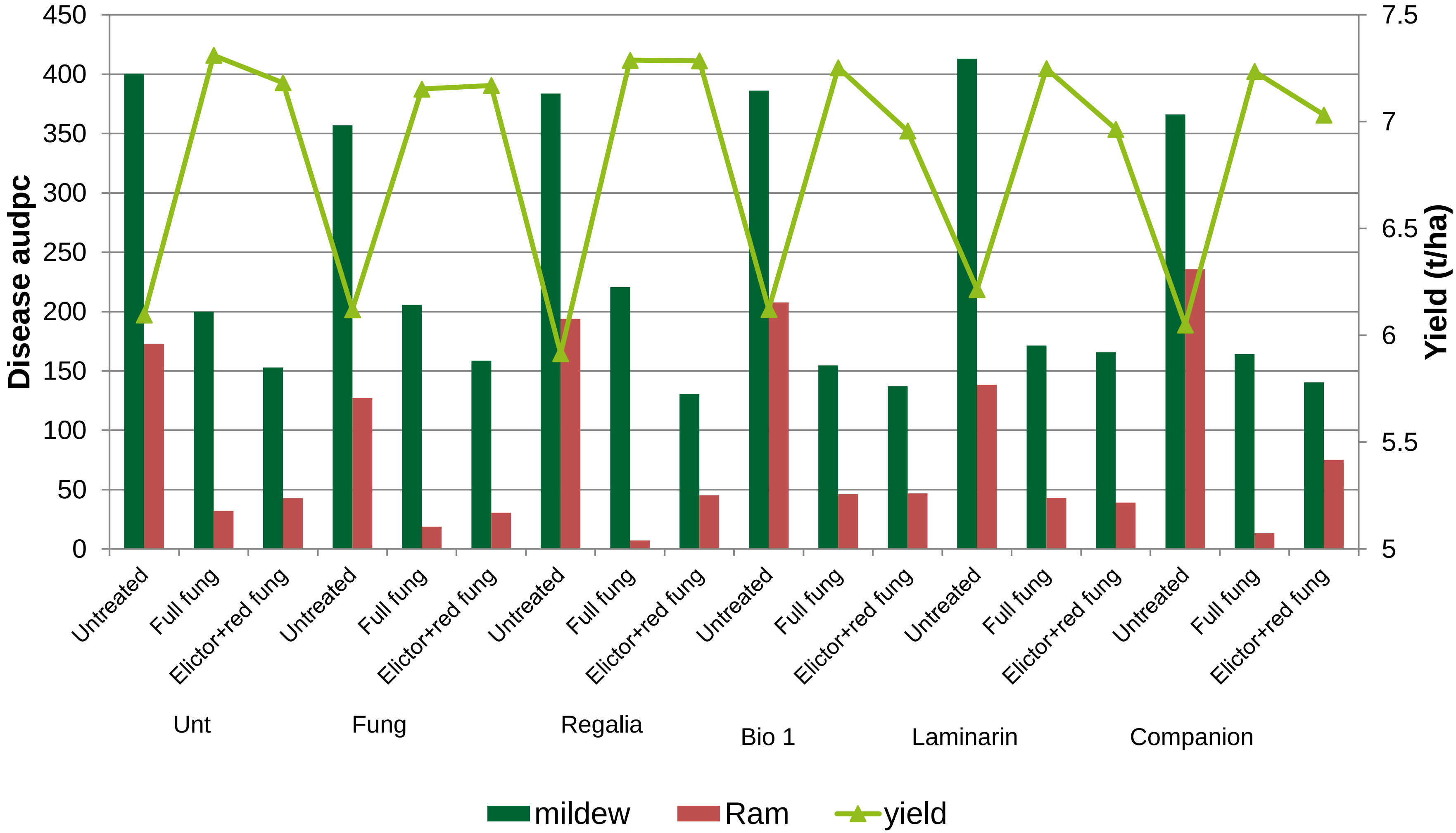
Effect of seed treatments on disease control in winter barley



LSD Mild 77.9; Rhyn 36.2; Ram 2.16; Yield 0.51

No sig yield increase

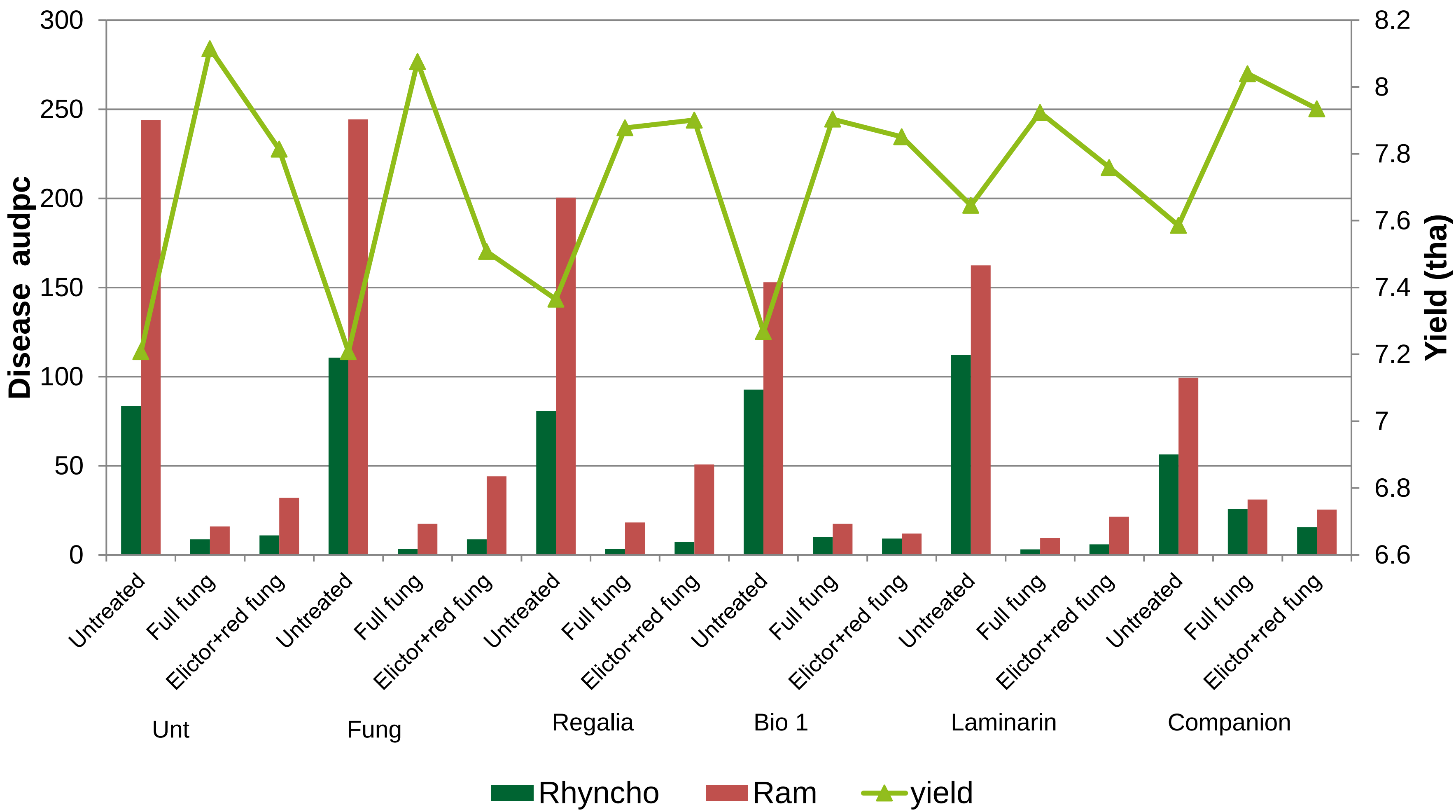
Effect of seed treatments on disease control in spring barley (cv Propino)



LSD (P=0.05) 103.1; Ram 140.8; Yield 0.4

Sig yield response

Effect of seed treatments on disease control in spring barley (cv Laureate)



LSD P=0.05 Rhyncho 29.6; Ram 140.8; Yield 0.4

Sig yield response

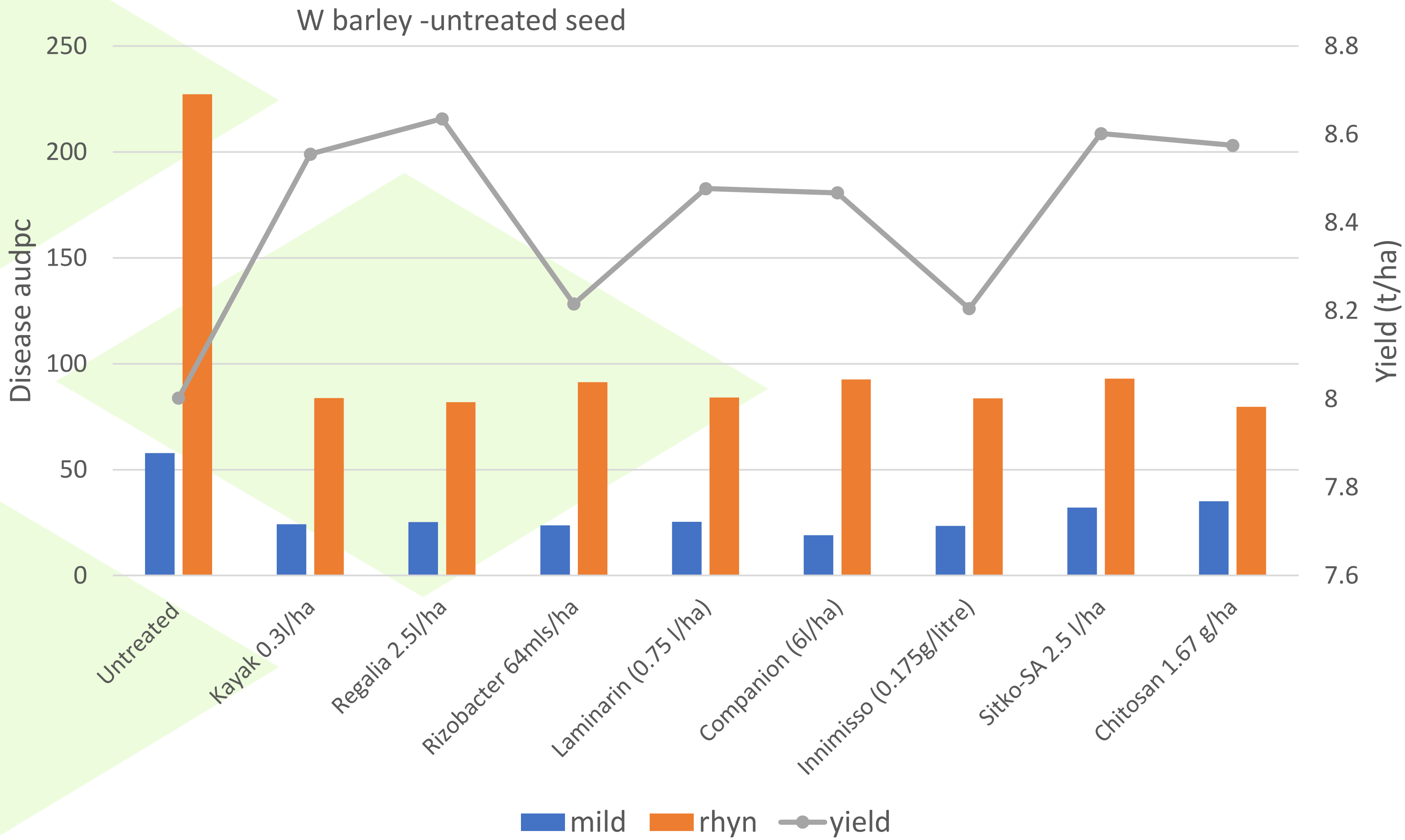
Evaluating T0 options

- Treated (Laminarin) and untreated seed given various T0 (GS 24) spray treatments followed by conventional fungicide programme at a reduced rate
- Kayak (0.3), Amino Flo (1.0), Biological 1, Laminarin (0.75), Companion (6.0), Bion (Innimisso) (0.175), Sitko-SA (2.5), Zynergy (1.0)

- T1 (GS 30) Siltra Xpro (0.25) + Comet (0.25)
- T2 (GS 53) Proline (0.25) + Bravo (1.0)

- Winter and spring barley trials scored for disease and taken to yield

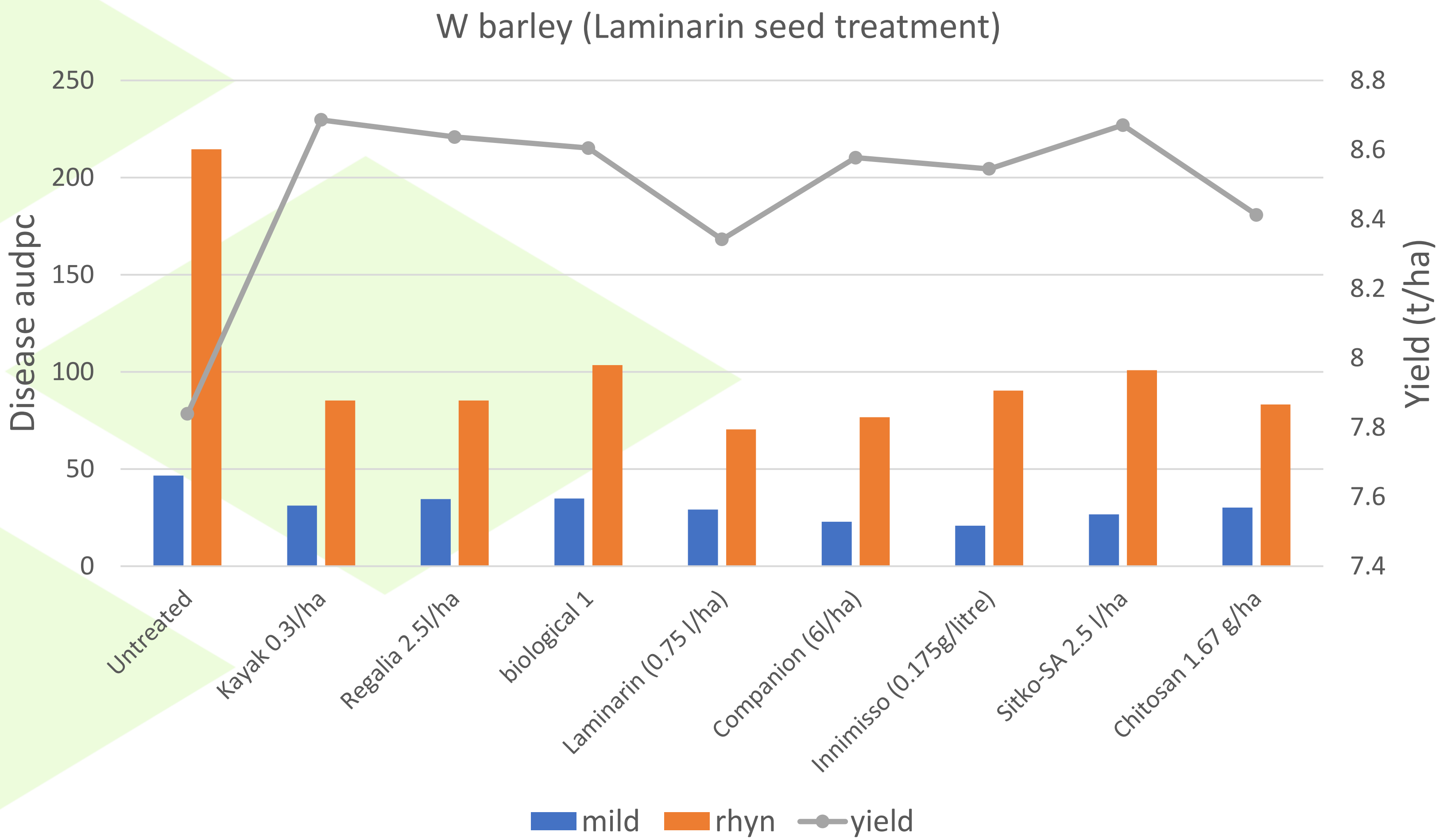
W barley (over years)



Sig yield response

LSD(P=0.05), Mildew 18.15; Rhyncho 102.9; Yield 0.56

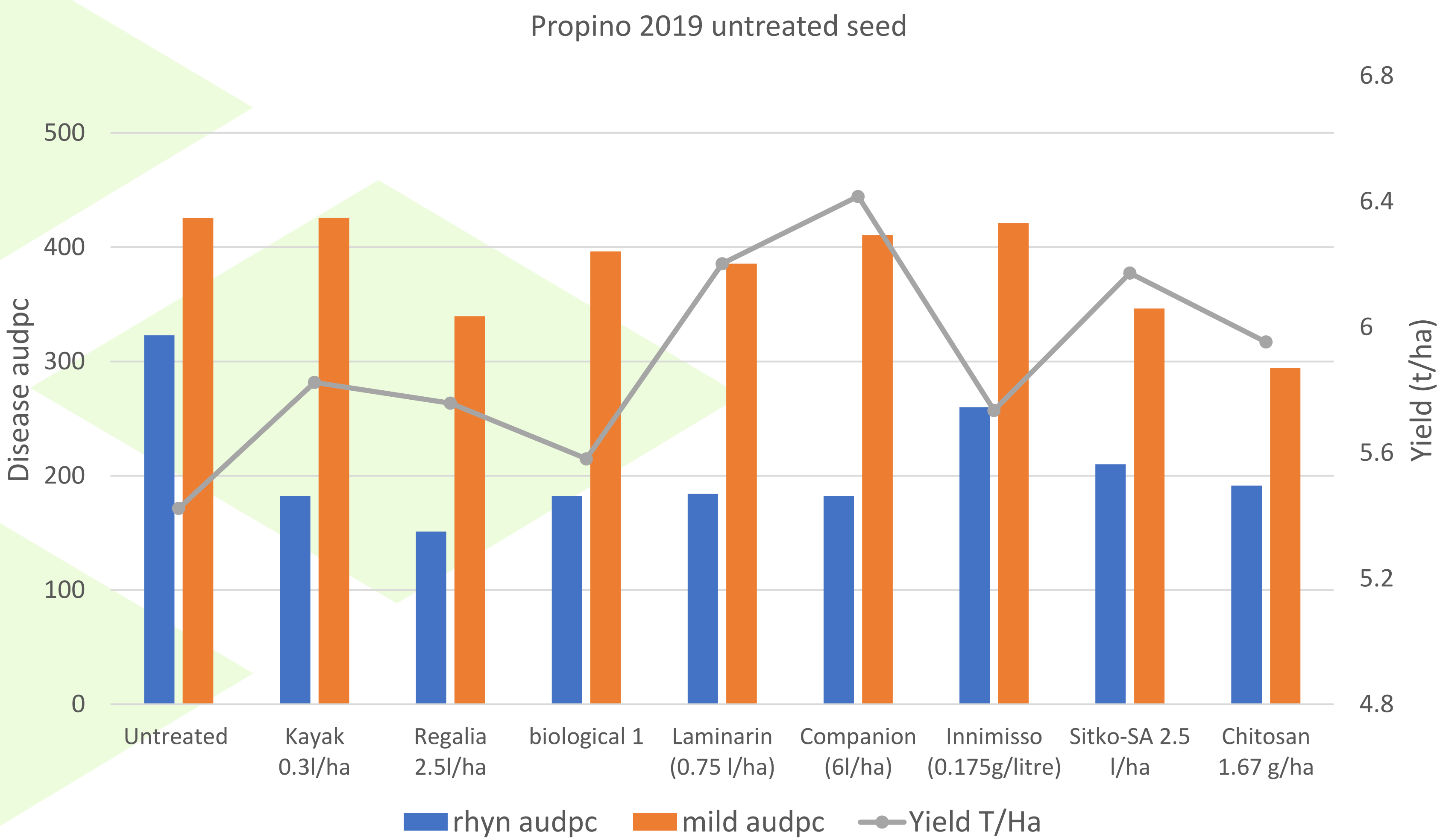
W barley (over years)



LSD(P=0.05), Mildew 18.15; Rhyncho 102.9; Yield 0.56

Sig yield response

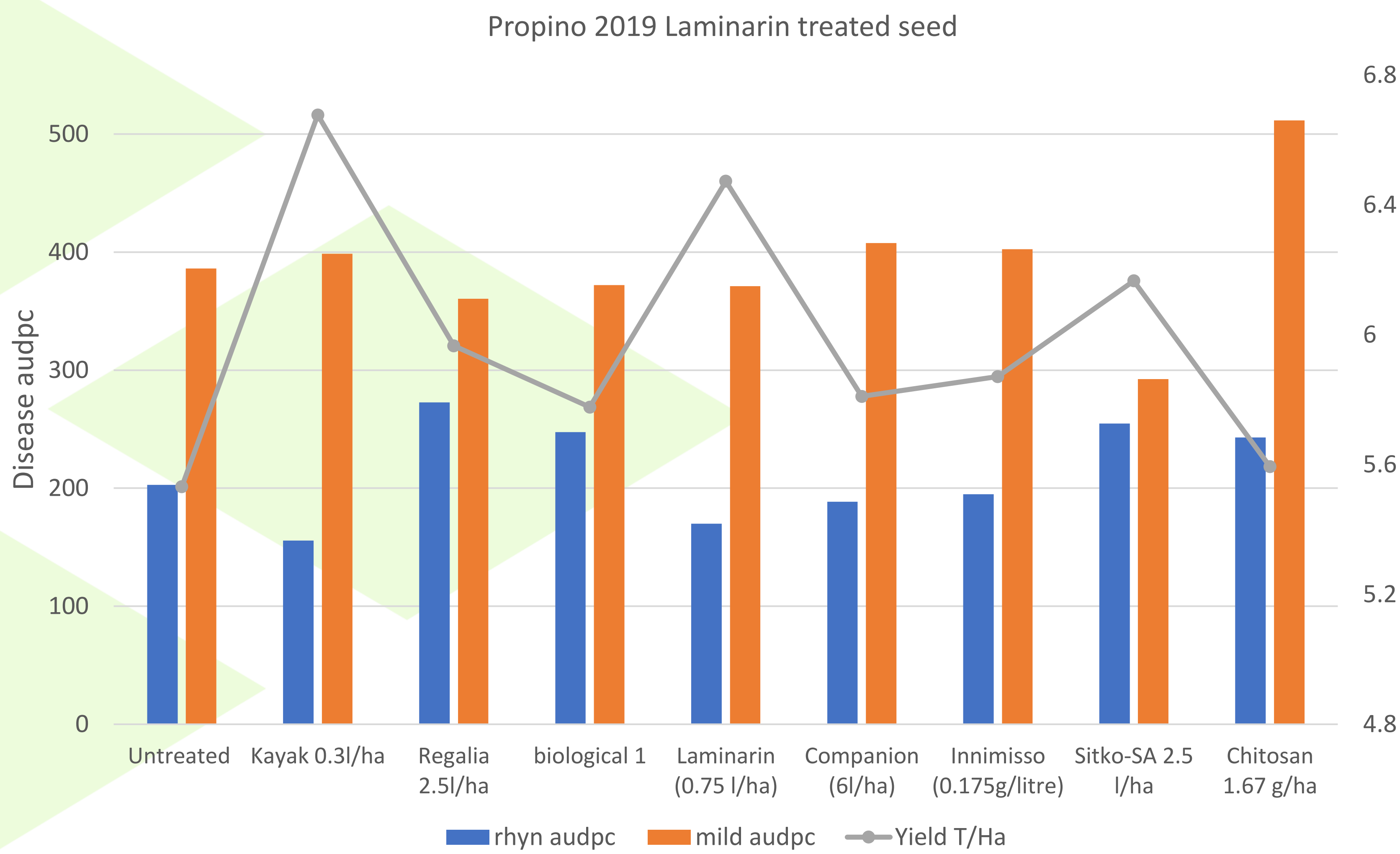
S barley 2019



LSD (P=0.05) Rhyncho 137.9; Mildew 95.9; Yield 1.24

No sig yield response

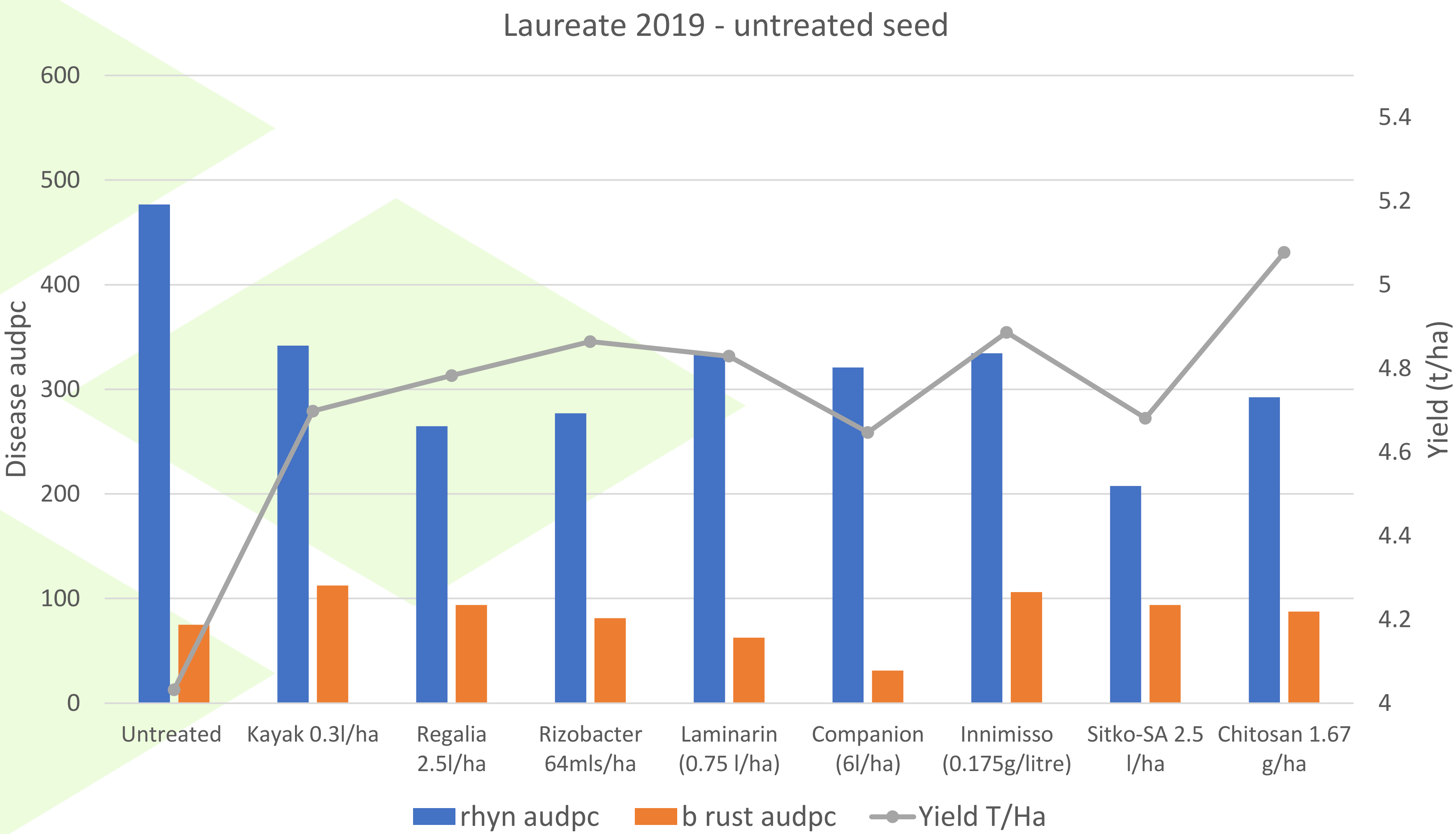
S barley 2019



LSD (P=0.05) Rhyncho 137.9; Mildew 95.9; Yield 1.24

No sig yield response

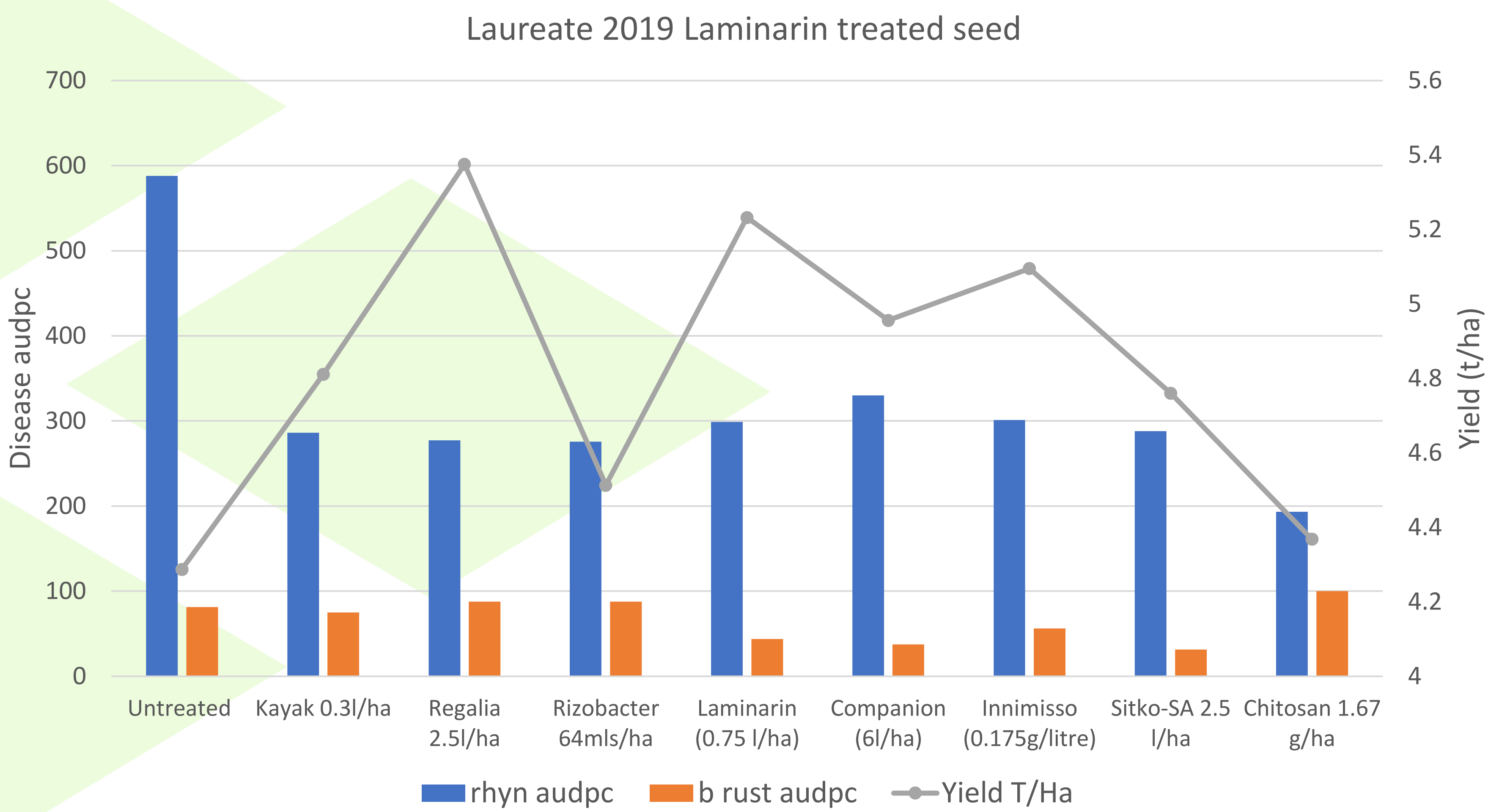
S barley 2019



LSD (P=0.05) Rhyncho 137.9; Mildew 95.9; Yield 1.24

No sig yield repsonse

S barley 2019



LSD (P=0.05) Rhyncho 137.9; Mildew 95.9; Yield 1.24

No sig yield response

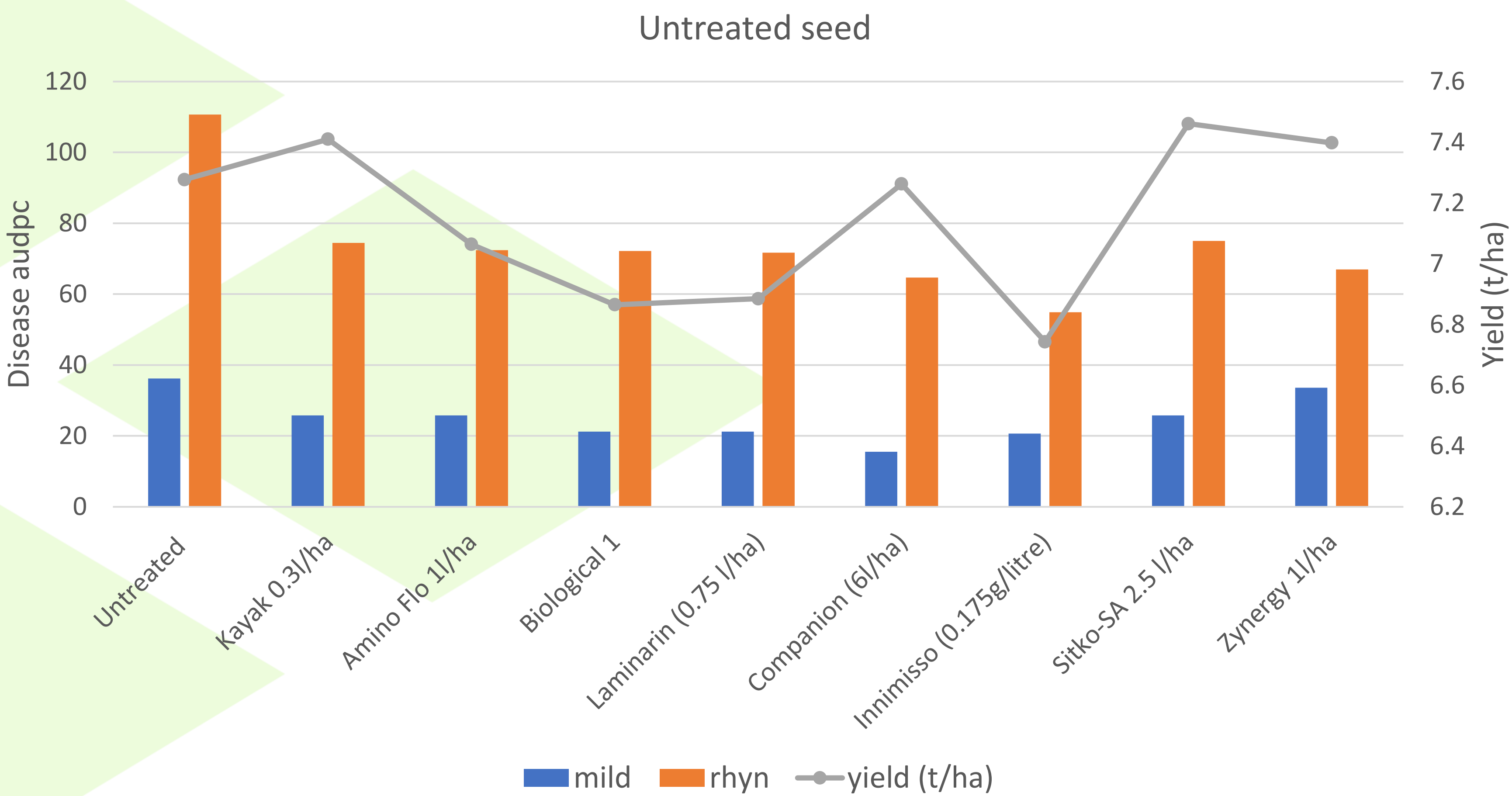
Evaluating T0 options (2020 onwards)

- Treated (Laminarin) and untreated seed given various T0 (GS 24) spray treatments followed by conventional fungicide programme at a reduced rate
- Kayak (0.3), Amino Flo (1.0) or Phyter (2.0), Biological 1, Laminarin (0.75), Companion (6.0), Bion (Innimisso) (0.175), Sitko-SA (2.5), Zynergy (1.0)

- T1 (GS 30) Siltra Xpro (0.25) + Comet (0.25)
- T2 (GS 45) Revystar (0.35) + Folpet (0.5)

- Winter and spring barley trials scored for disease and taken to yield

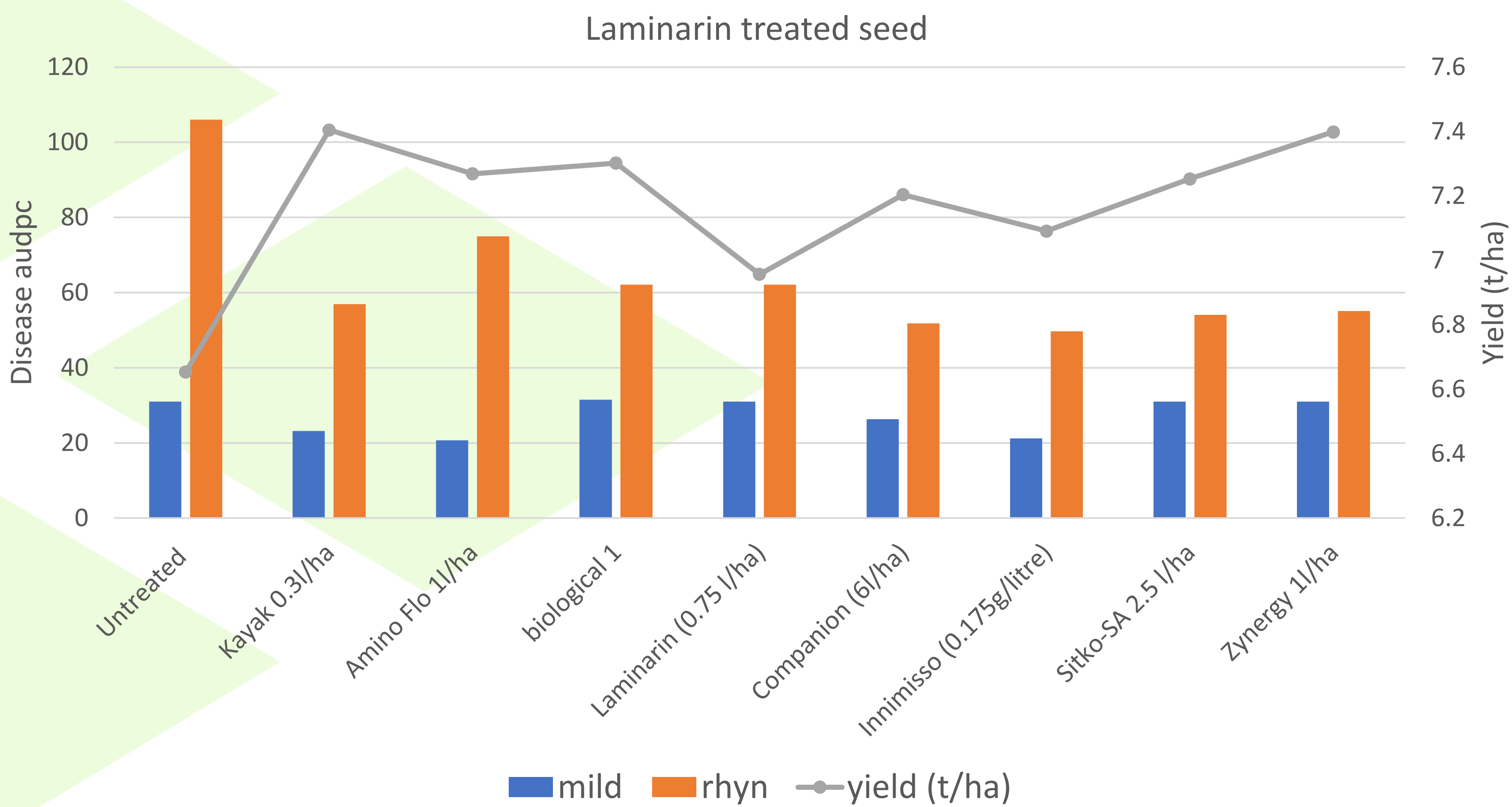
W barley 2020



LSD (P=0.05) Mild 22.48: Rhyncho 27.99; Yield 0.592

No sig yield response

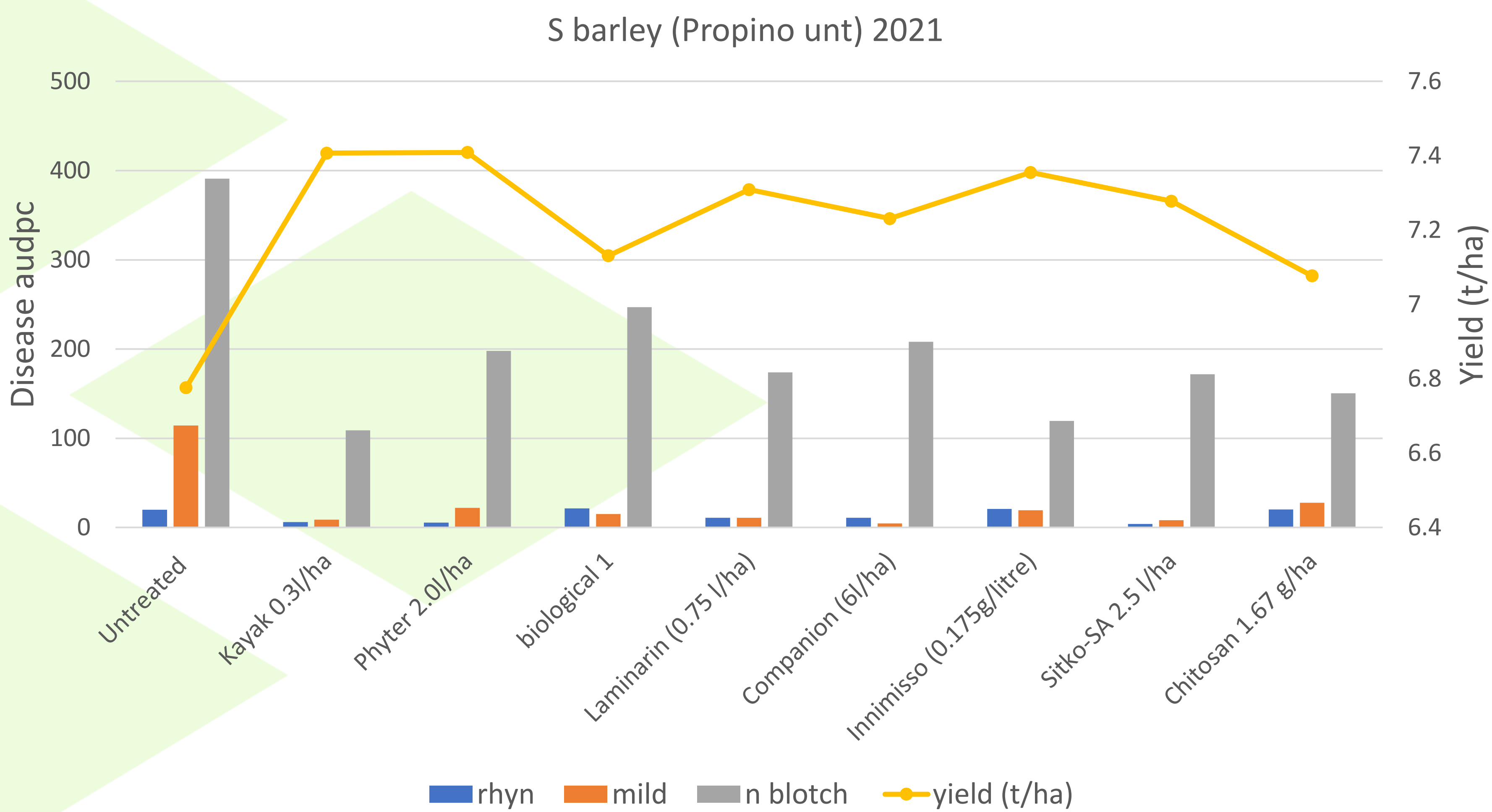
W barley 2020



LSD (P=0.05) Mild 22.48: Rhyncho 27.99; Yield 0.592

Sig yield response

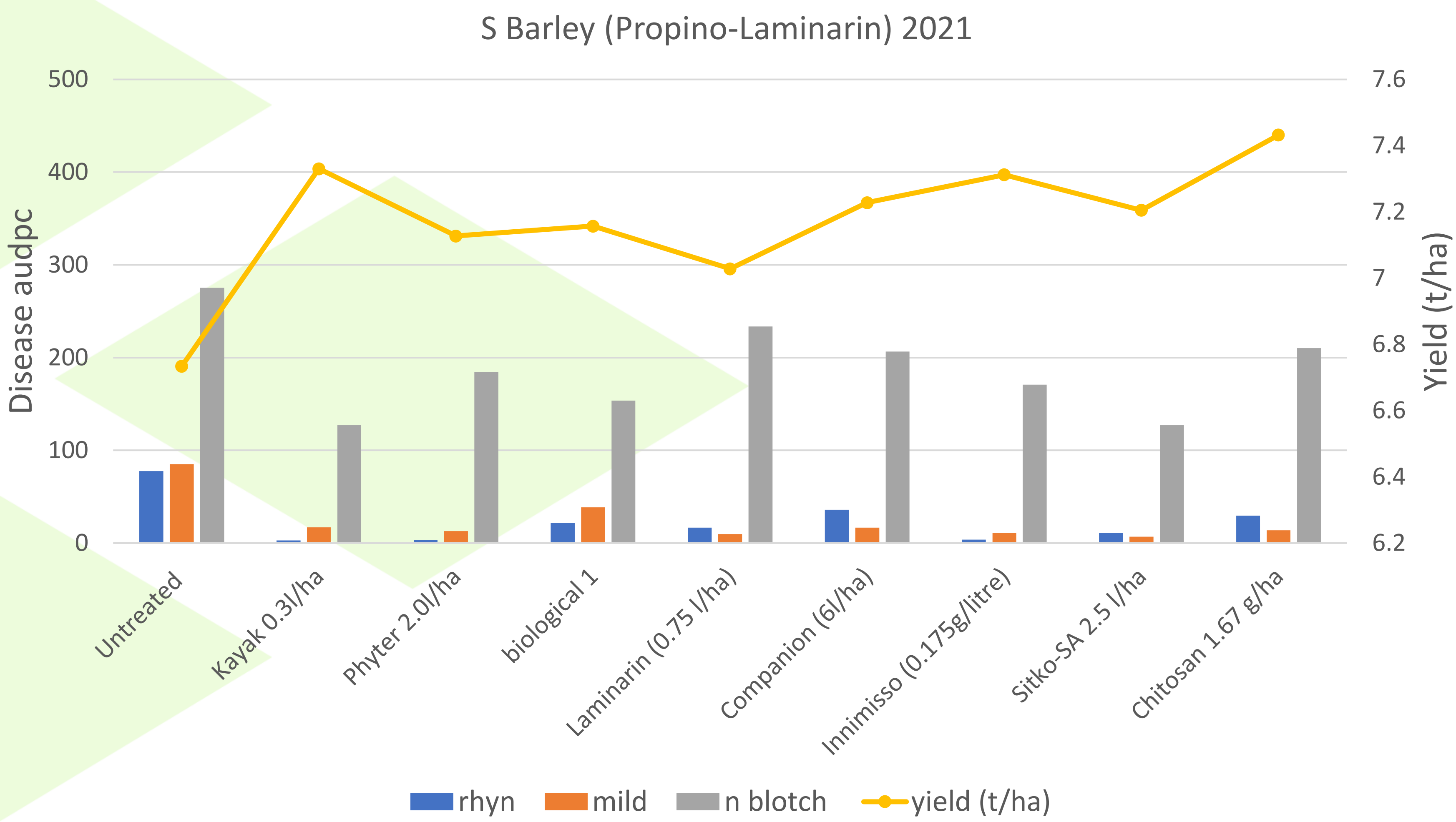
S barley 2021



LSD P=0.05 Rhyn 22.0; Mild 30.69; N Blotch 109.26; Yield 0.296

Sig yield response (not chitosan)

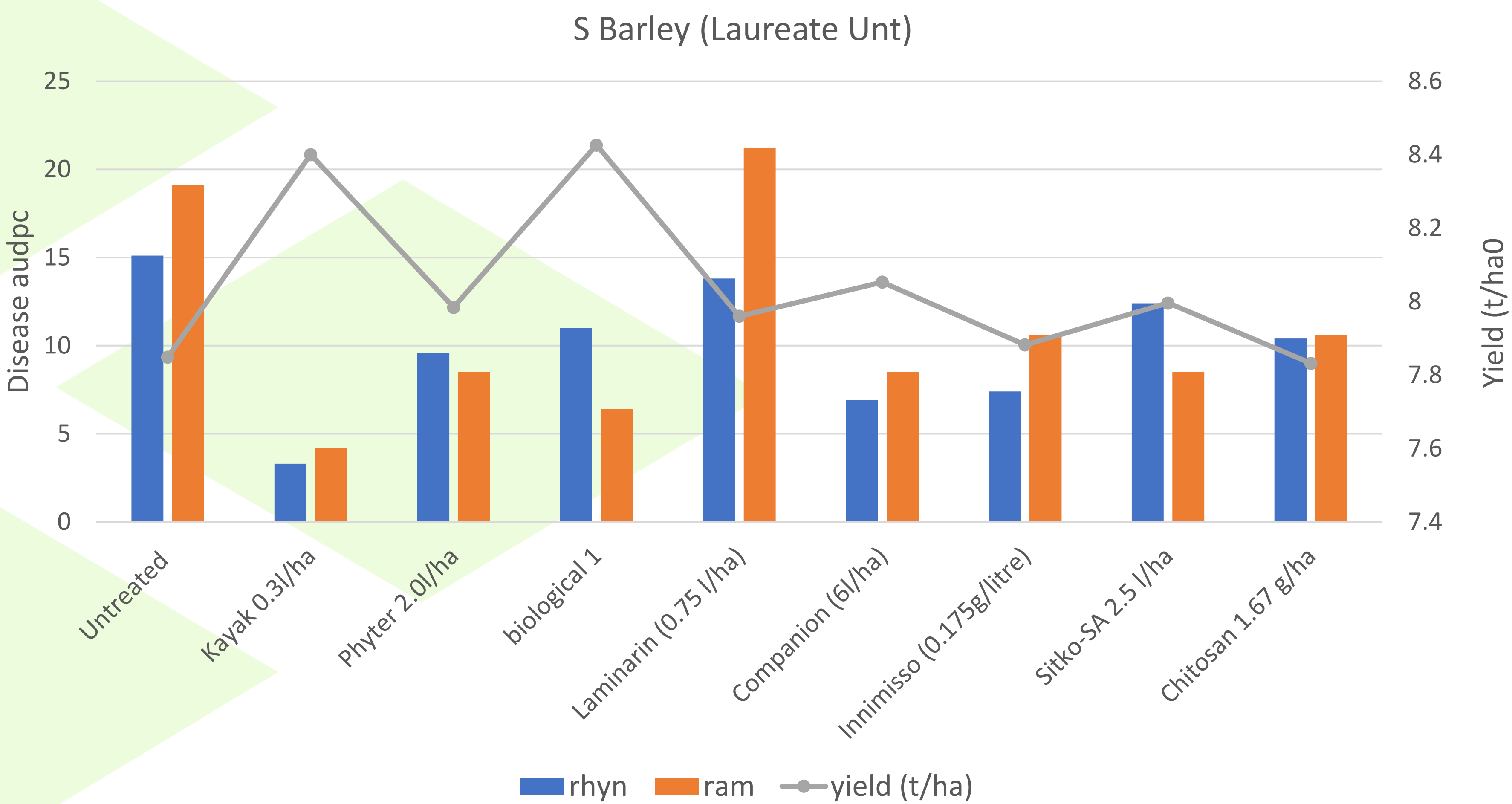
S barley 2021



LSD P=0.05 Rhyn 22.0; Mild 30.69; N Blotch 109.26; Yield 0.296

Sig yield response

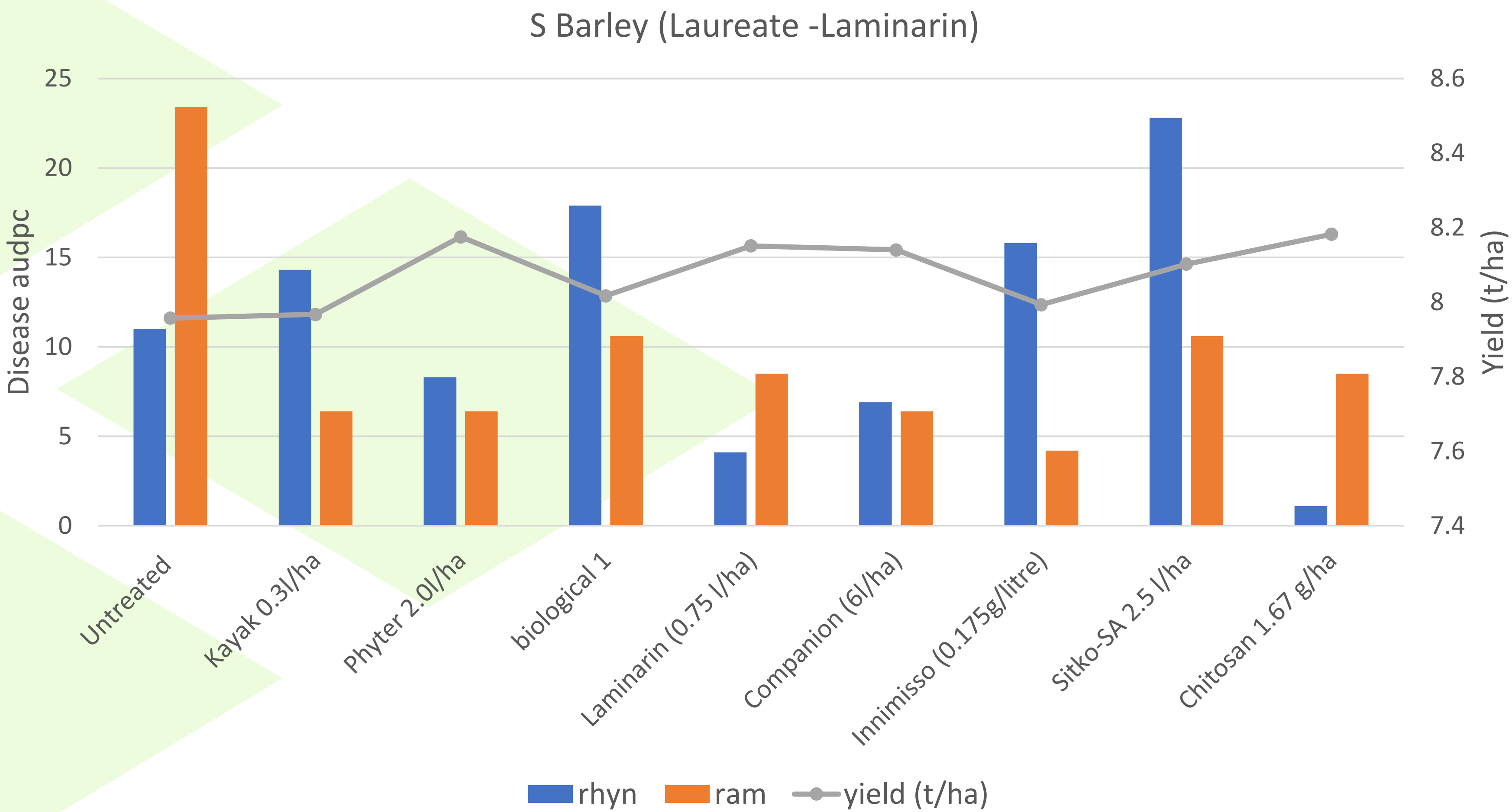
S barley 2021



LSD (P=0.05) Rhyncho 22.0; Ram 17.25; Yield 0.296

Sig yield response for 2 treatments

S barley 2021



No sig yield response

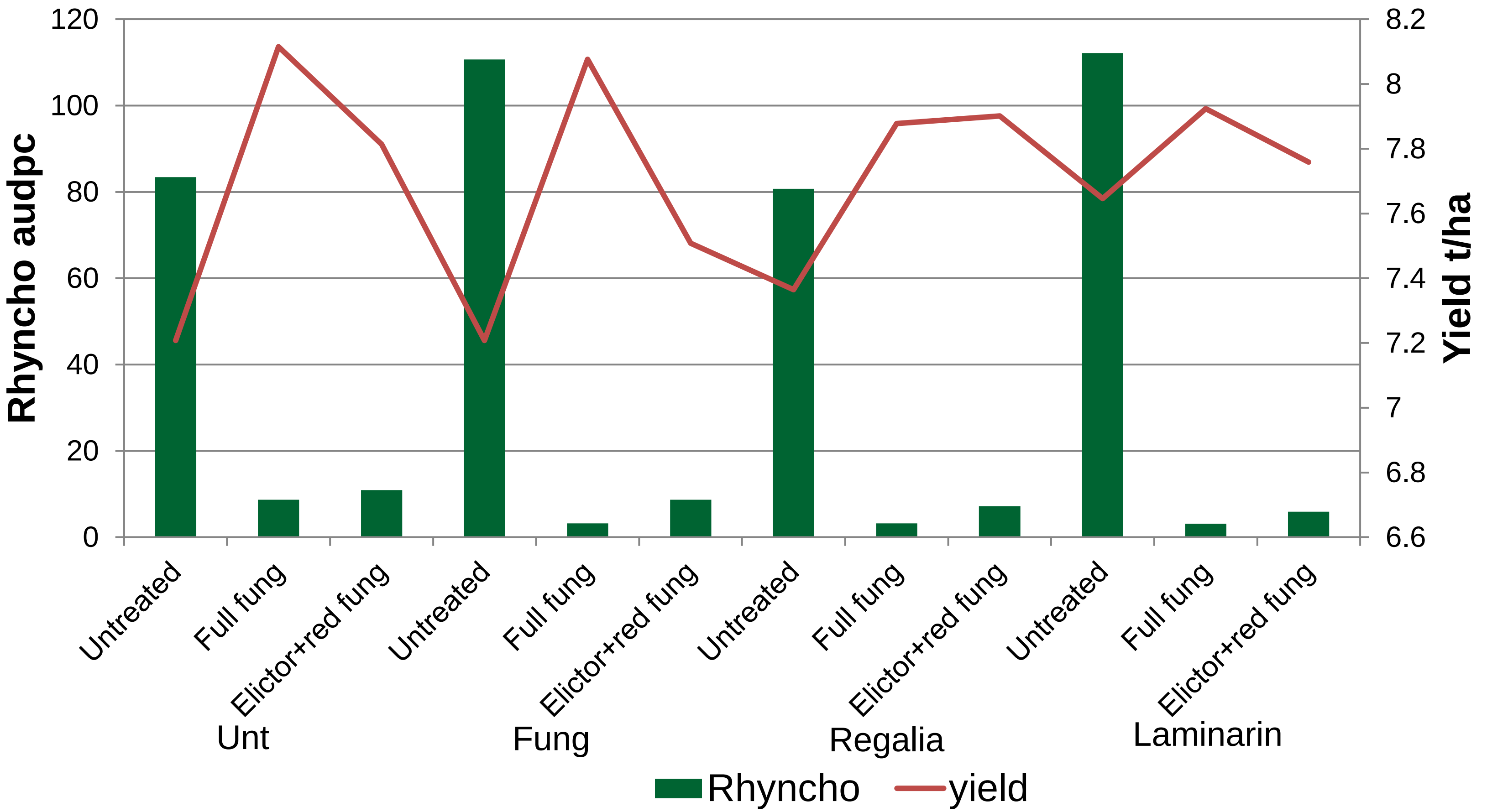
LSD (P=0.05) Rhyncho 22.0; Ram 17.25; Yield 0.296

Spring barley IPM trial cv Laureate

£51
Full

£39
Lam
+Red
rate

Yield benefit full programme =0.9 t/ha
= £153 feed or £181 malt
(AHDB SACC Harvest 2018 – ex farm)



Conclusions

- The integration of elicitors into programmes for cereal crops will require careful management
- Control will be more variable than that achieved by conventional programmes
- Seasonal disease pressure needs to be factored in to programmes
- The effects of crop stress may affect elicitor performance
- The influence of variety needs to be tested more extensively

Future prospects

- Conventional chemistry options reducing
- Increasing interest in eliciting the defence response in crops
- More products in testing
- Where is the line drawn between elicitors and biostimulants?
- New pipelines for registration?

Funding

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Thank you for your attention