Trinexapac-ethyl
MOA, effects and value

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Contents

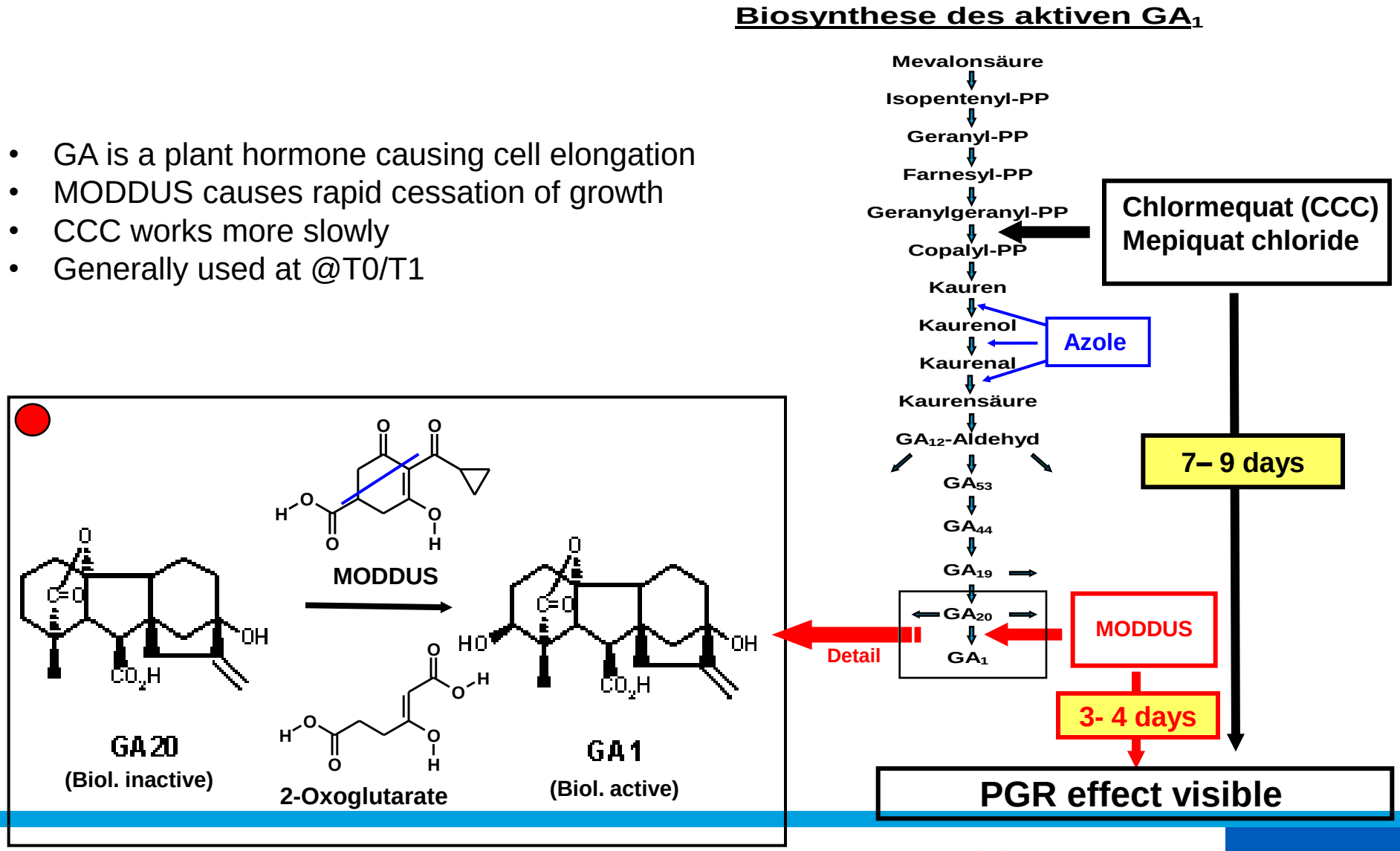
- TXP mode of action and uptake
- TXP effects on the plant
  - Photosynthesis, carbohydrate utilisation efficiency (harvest index)
  - Rooting effects – anchorage strength, water and nutrient use efficiency (T0)
  - Stem strength and height reduction (T1)
- The impact of lodging (Cereals)

- **MODDUS Start**
  - **Built on 20 years of Syngenta TXP 'know-how'**
  - **Designed to maximise performance and benefits.**

PGR – Mode of action

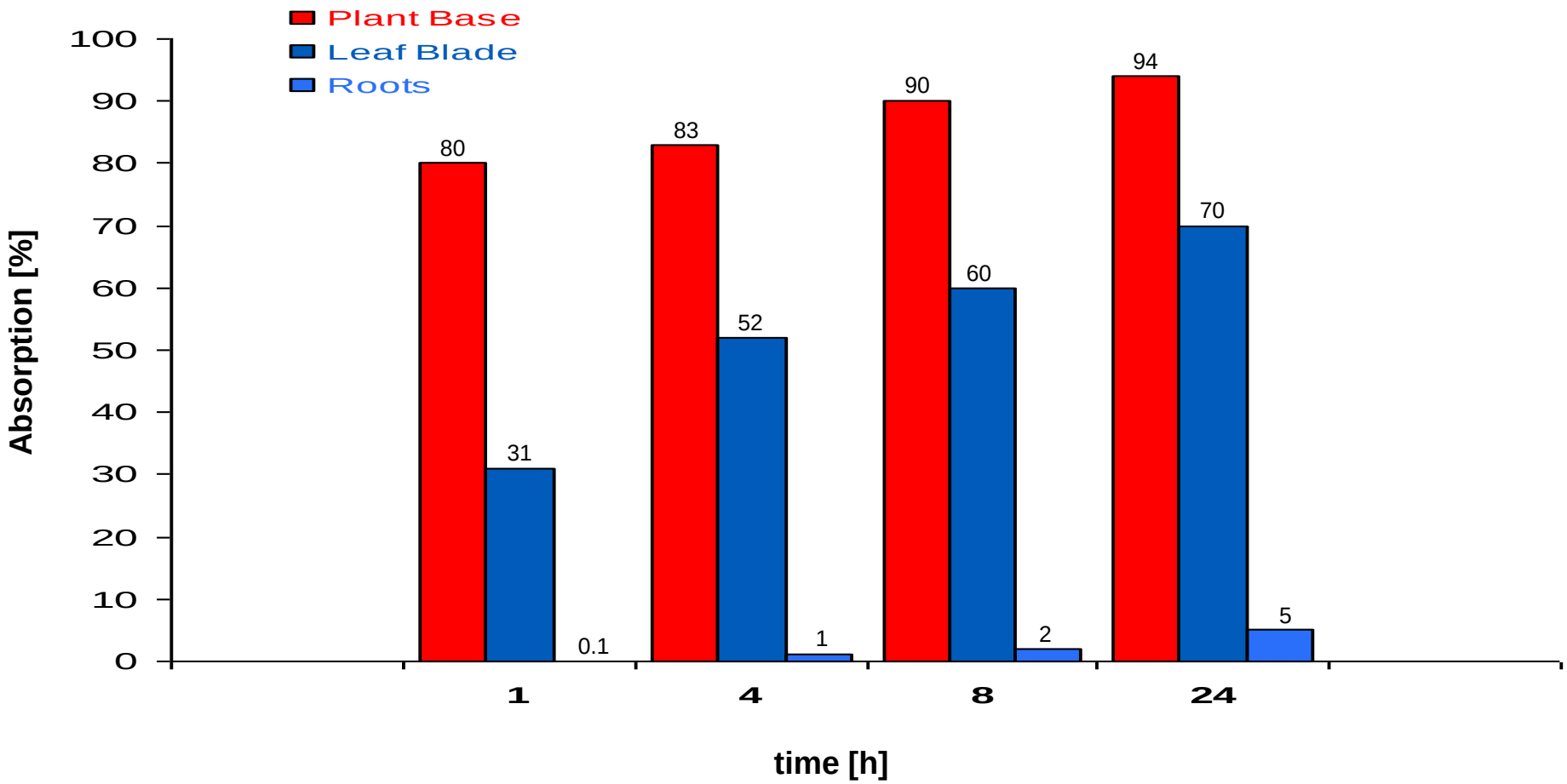
1) GA production inhibition

- GA is a plant hormone causing cell elongation
- MODDUS causes rapid cessation of growth
- CCC works more slowly
- Generally used at @T0/T1



Source: Adams & Weiler ,1991,University Bochum

Absorption of 14C-TXP over a 24 h period from three sites of uptake



(taken from Fagerness and Penner, 1998)

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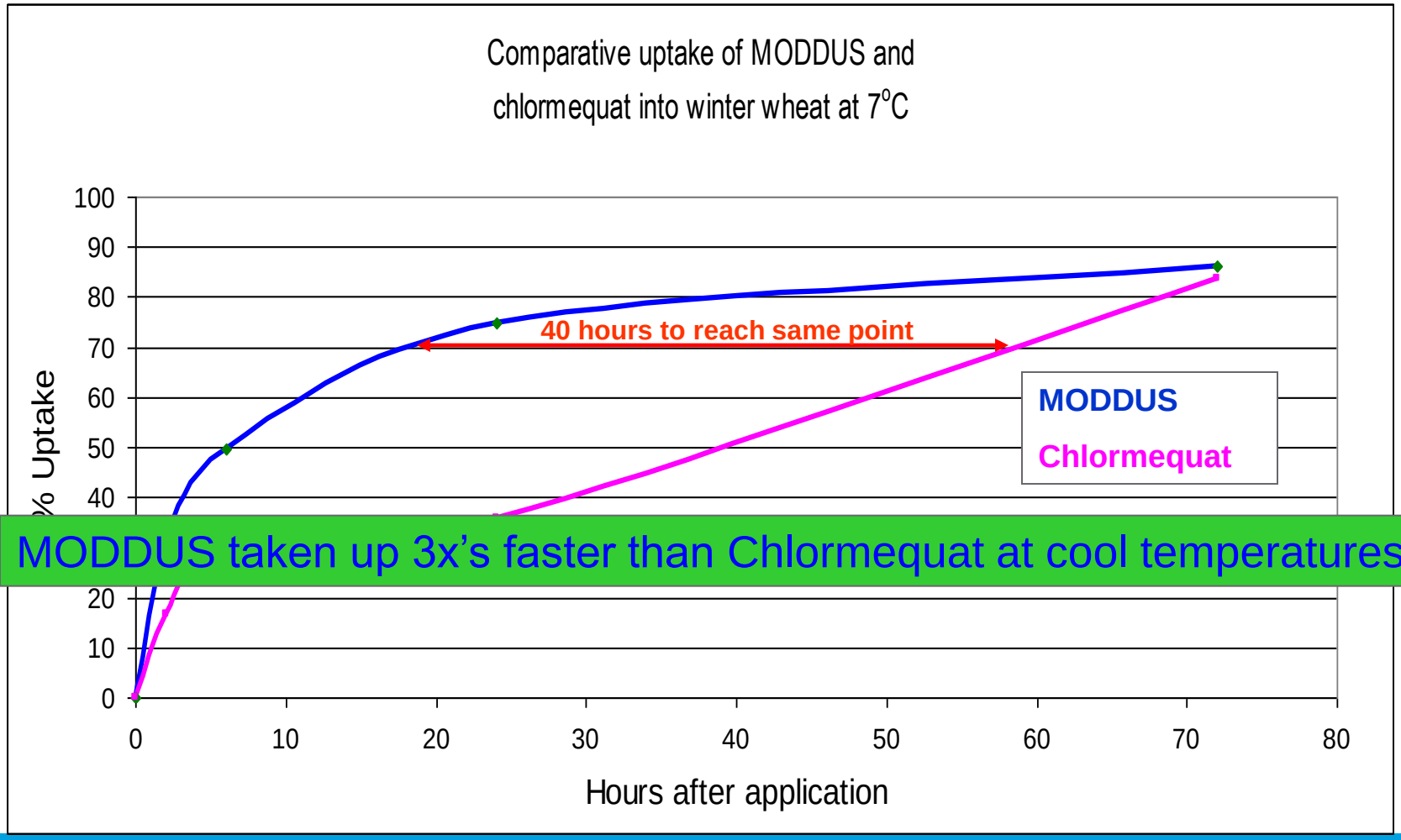
MODDUS - early season activity in the cold



MODDUS taken up 3x's faster than Chlormequat at cool temperatures

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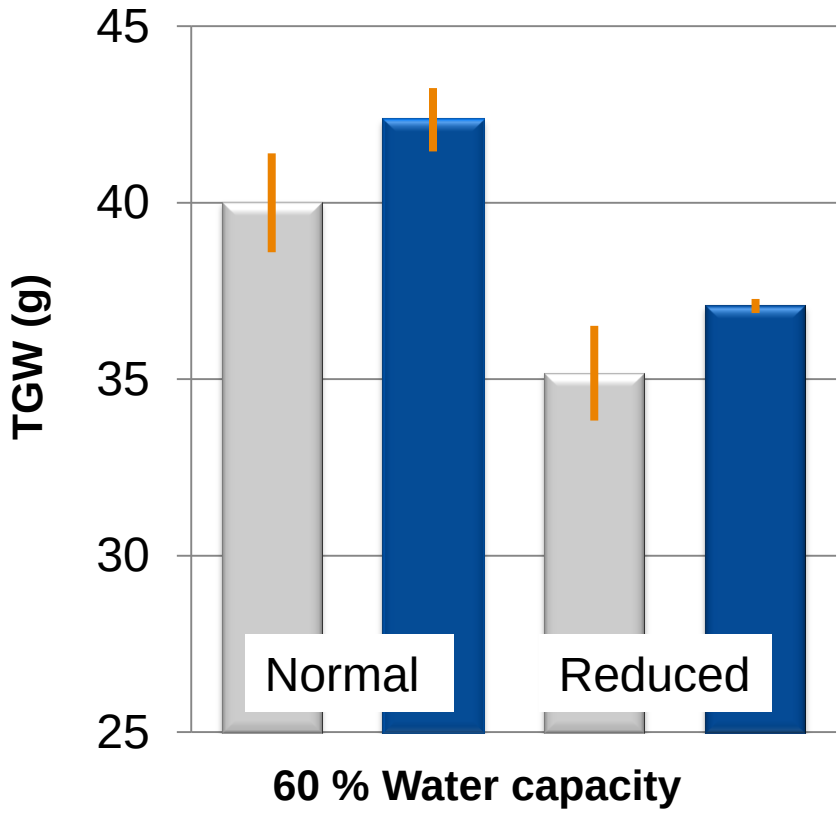
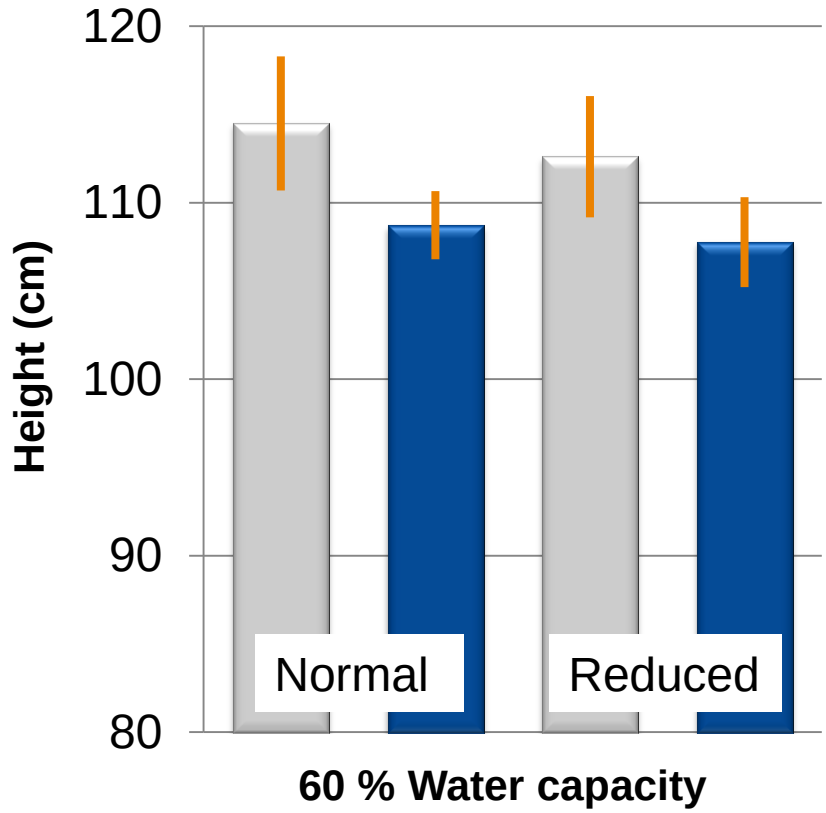
Influence of light intensity on the effect of Moddus in wheat (Giessen, 2007 - Variety Monopol)





Error bars indicate standard error
* = Significant at p = 0.05

Untreated | Moddus

No impact on ear number or no grains

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PGRs – when to apply

- Syngenta data shows significant positive impact of MODDUS Start at T0 – it works if applied from GS25 onward…
- ACTIVE GROWTH is key
- Without it there is no or lower growth to regulate and no effects will be expressed.
  - Low light
  - Low nutrients
  - Low water
  - Low temperature
  - Any form of stress – can negatively impact growth
- Do not apply to already stressed plants.
- Plants that arent growing don’t need a PGR and it can exacerbate stress!
- APPLY with active growth or the expectation of it.
- The longer after application before active growth starts, the lower will be the activity of ANY PGR

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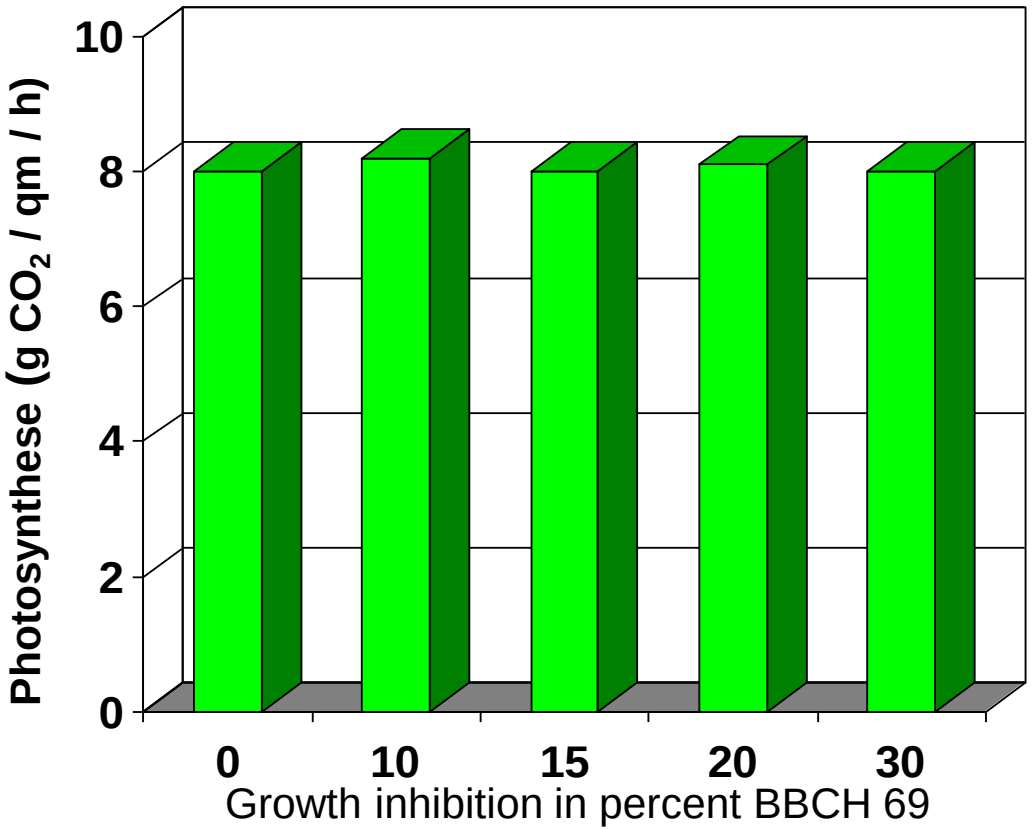
Moddus - influence on photosynthesis



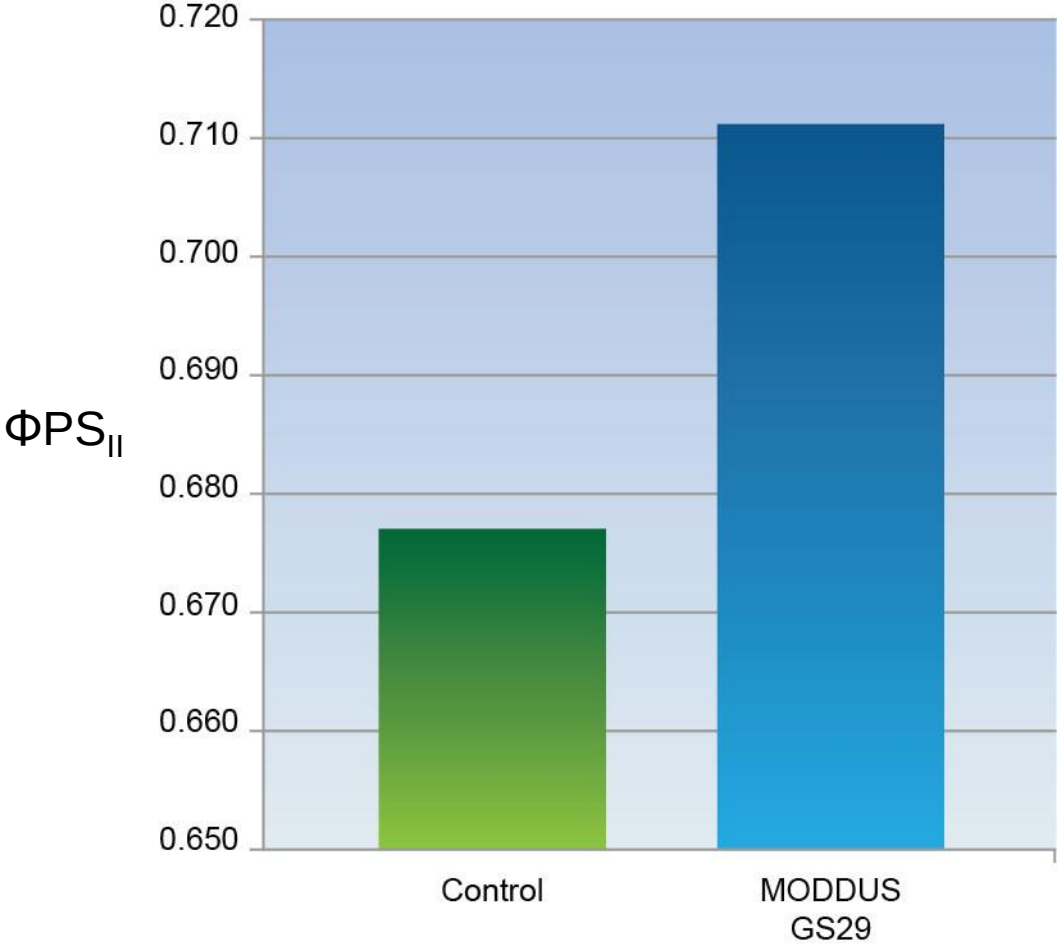
method:
Wheat, Field trial

increasing Moddus-
doses applied at BBCH 33

Photosynthesis
measurement end
flowering

MODDUS – pre stress conditioning

Brooms Barn – droughted plots – enhanced photosynthetic efficiency ΦPS_{II}

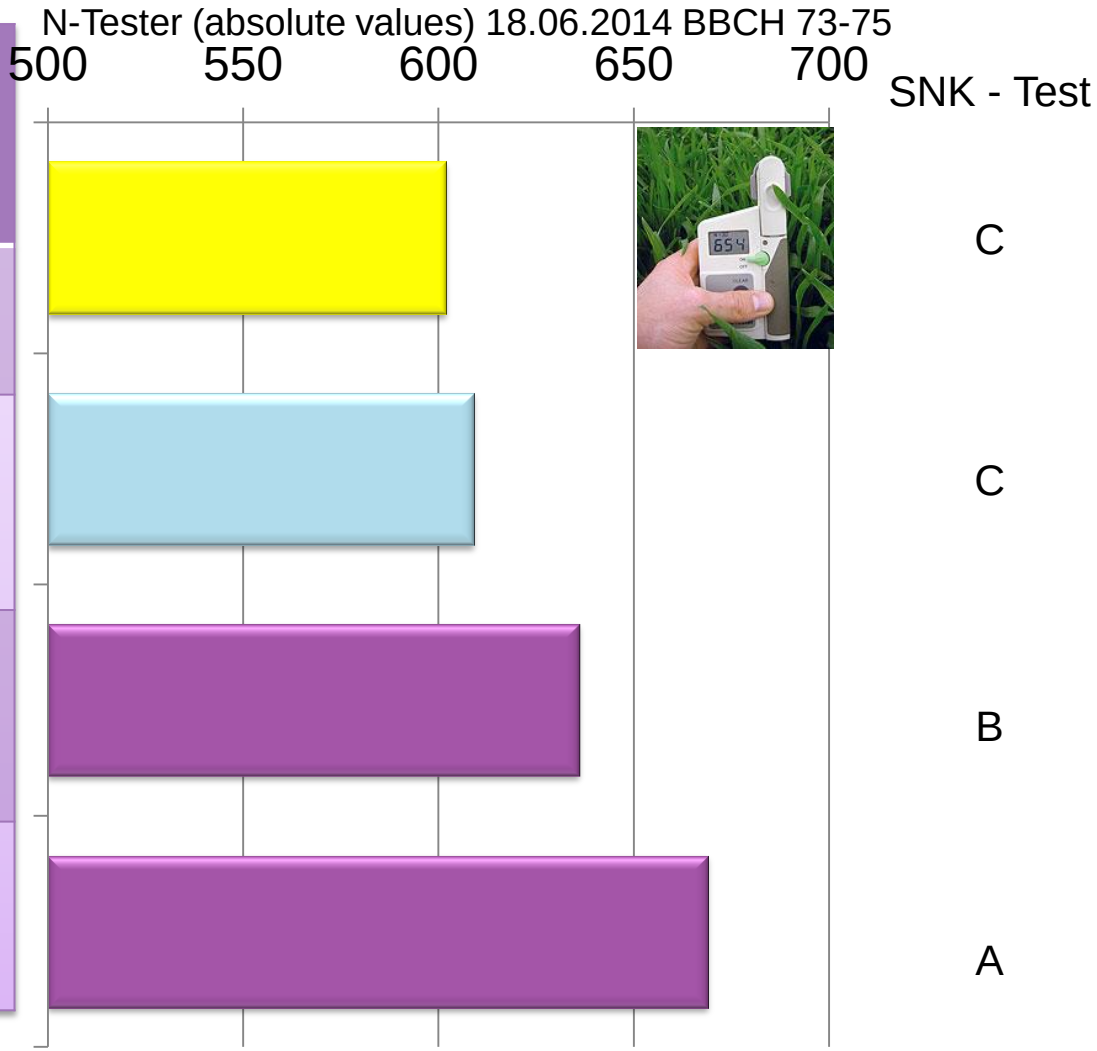


Yield increased by 8%
Ears/m2 increased by 21%

Chlorophyll concentration after PGR use

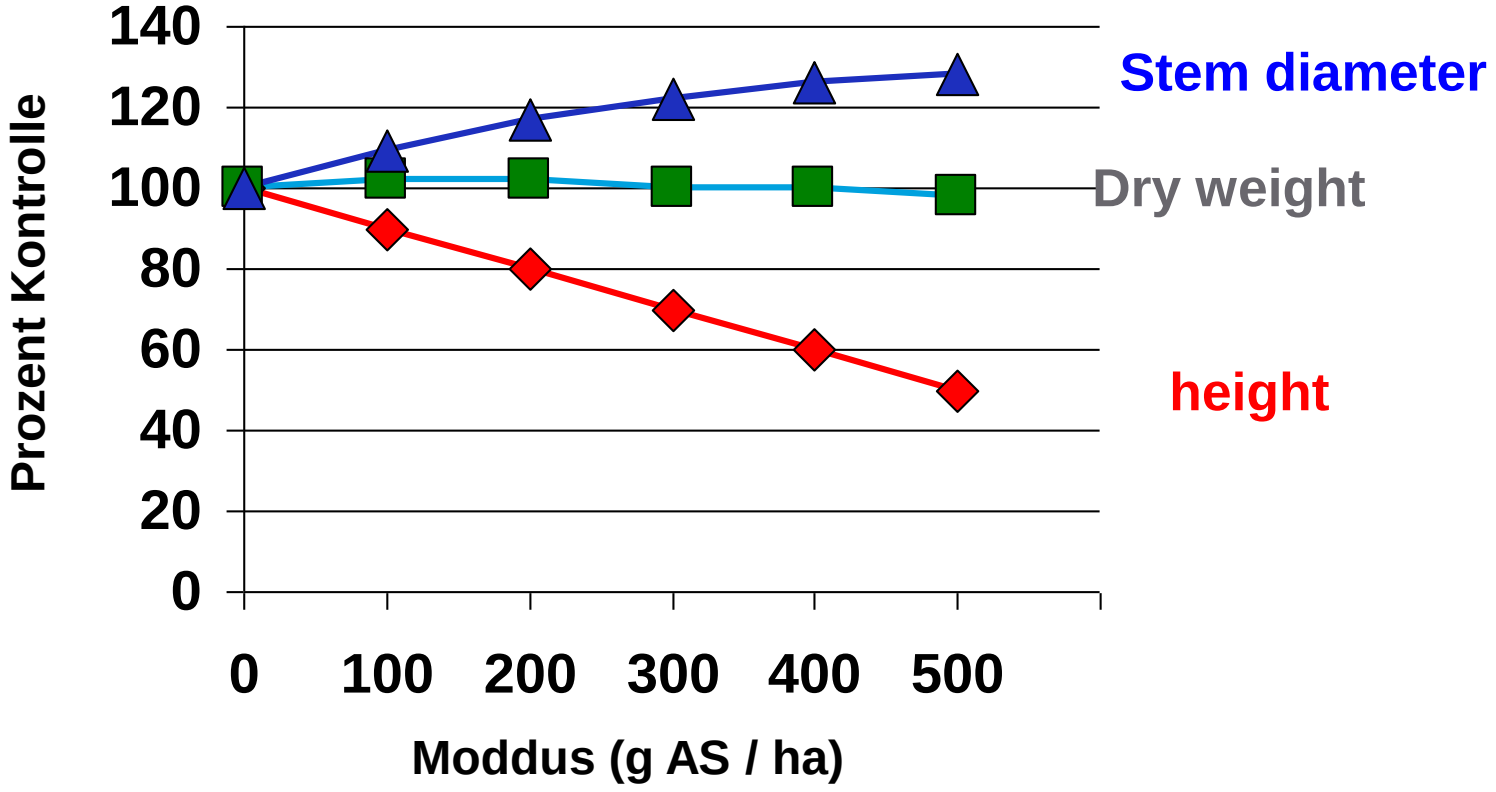
Harmshagen (DE), Winter wheat, Variety Paroli, 4 x 30 flag leaves per tmt

02.04.2014 **BBCH 28-30**	12.04.2014 **BBCH 32**
control	
CCC 1,0 l/ha	CCC 1,0 l/ha
Moddus Start 0,3 l/ha	
Moddus Start 0,3 l/ha	Moddus + CCC 0,2 l/ha + 0,5 l/ha



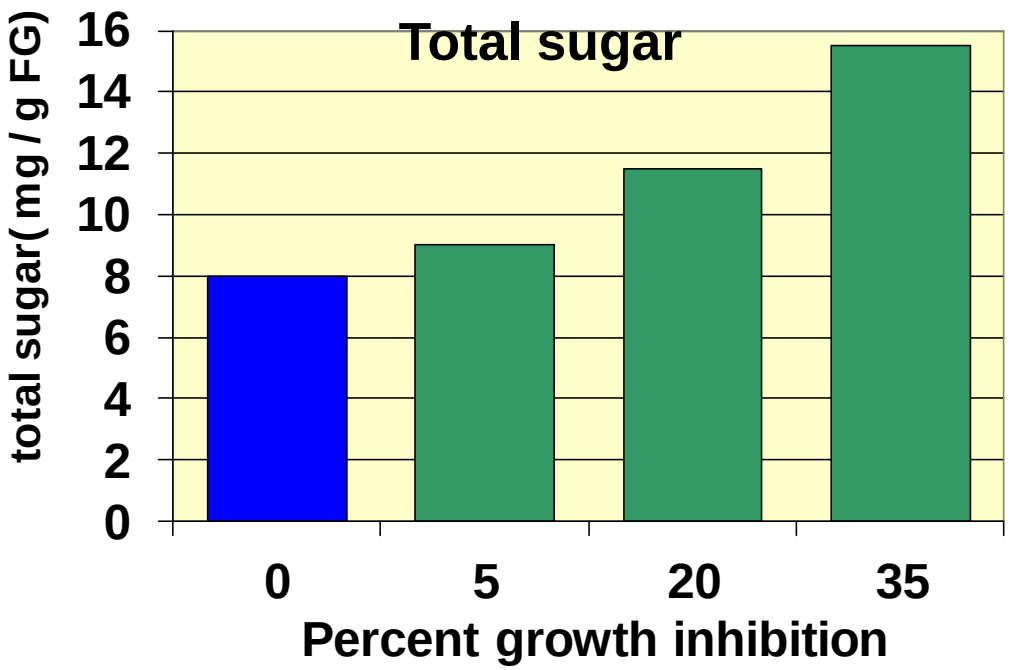
Moddus- influence on plant height, dry weight and culm diameter

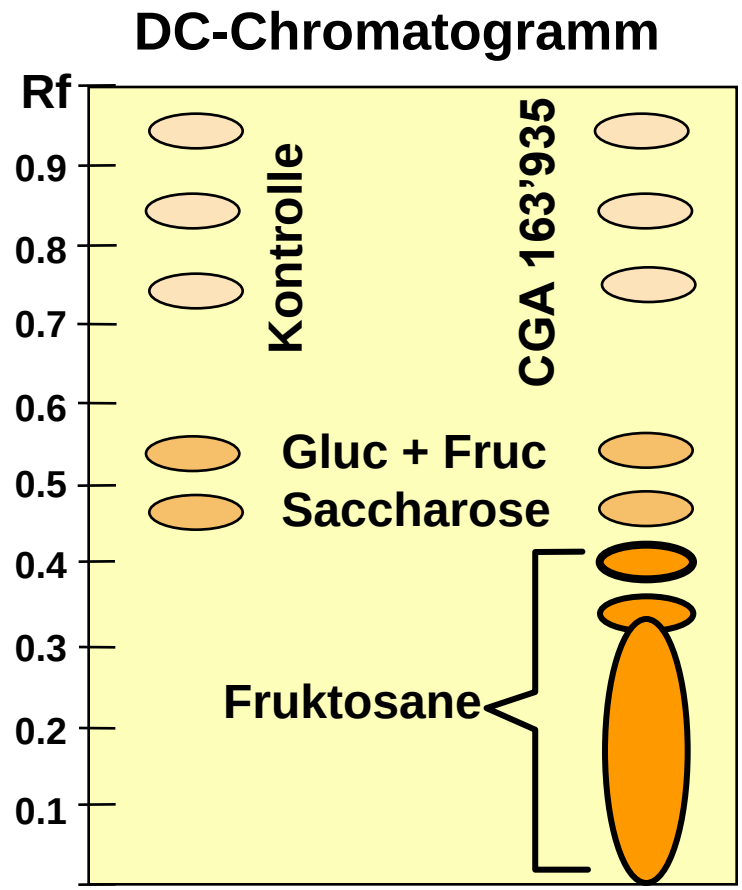
Method: barley, greenhouse, 30 days after application



Effects on carbohydrate content

Wheat seedlings,growth chamber application in the 2-leaf stage
Analyzes 4 days post treatment

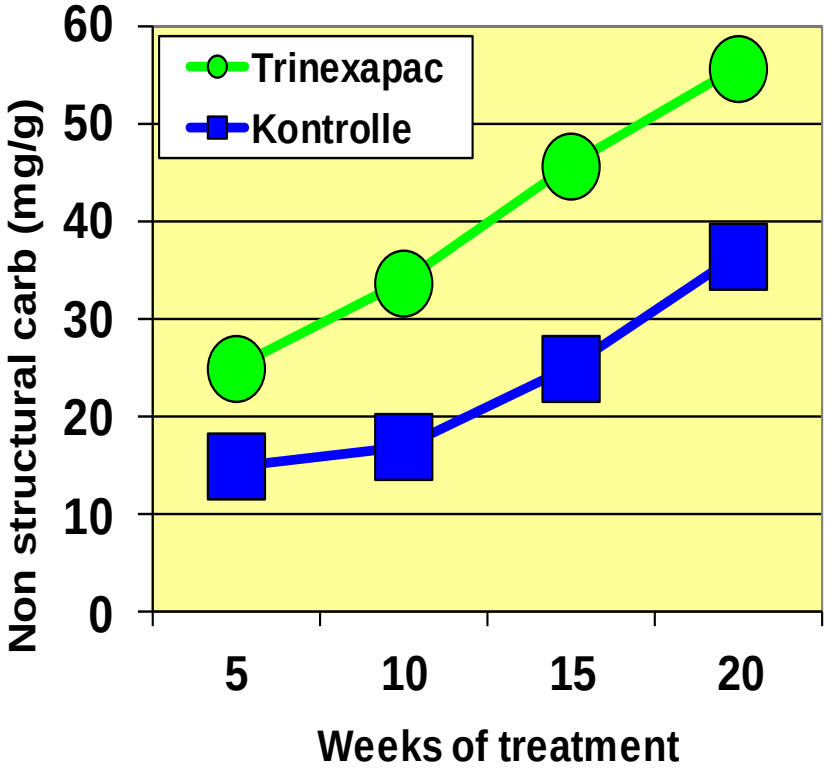




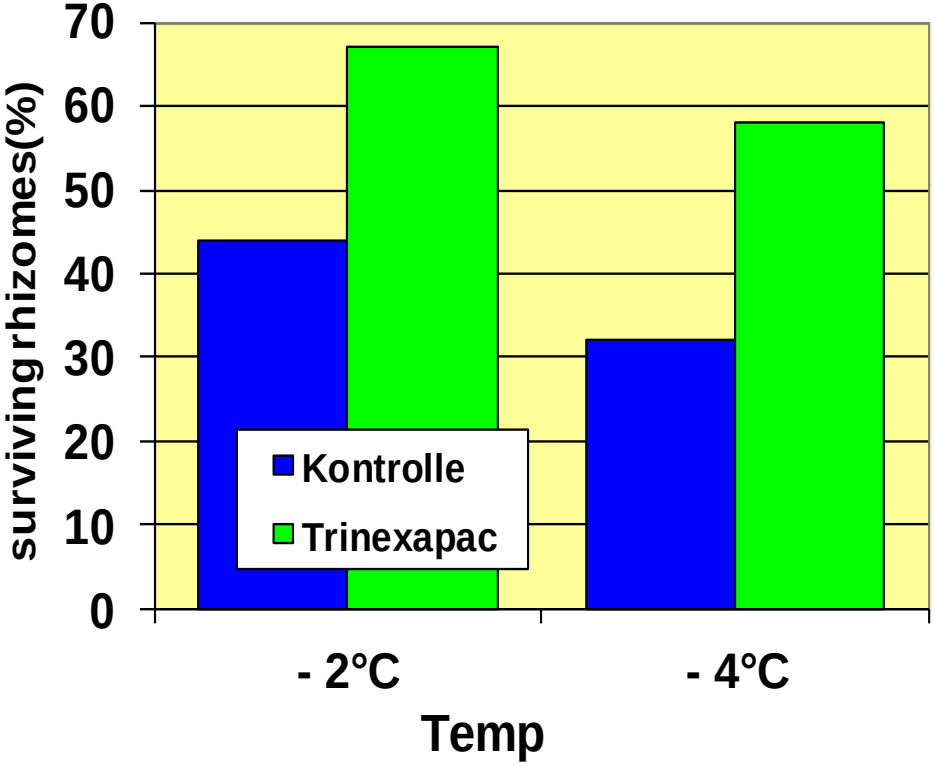
Photosynthesis unaffected…
Upward growth slowed…
Photosynthate has to go somewhere…?

Effects on carbohydrate content Turf:

Nonstructural carbohydrates
Zoysia turf, USA 1999
Application: monthly 50 g ai / ha



frost resistance
Bermudagrass, 2x100 g AS
Cold test 100 days AA.
USA, 2000



Variety ‘Таня’ Winter Wheat, Russia
0.2l/ha MODDUS at GS23 (pre winter). Photo March…

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Profitability in lodging free cereals France / Germany

France

166 trials ,1991-2003

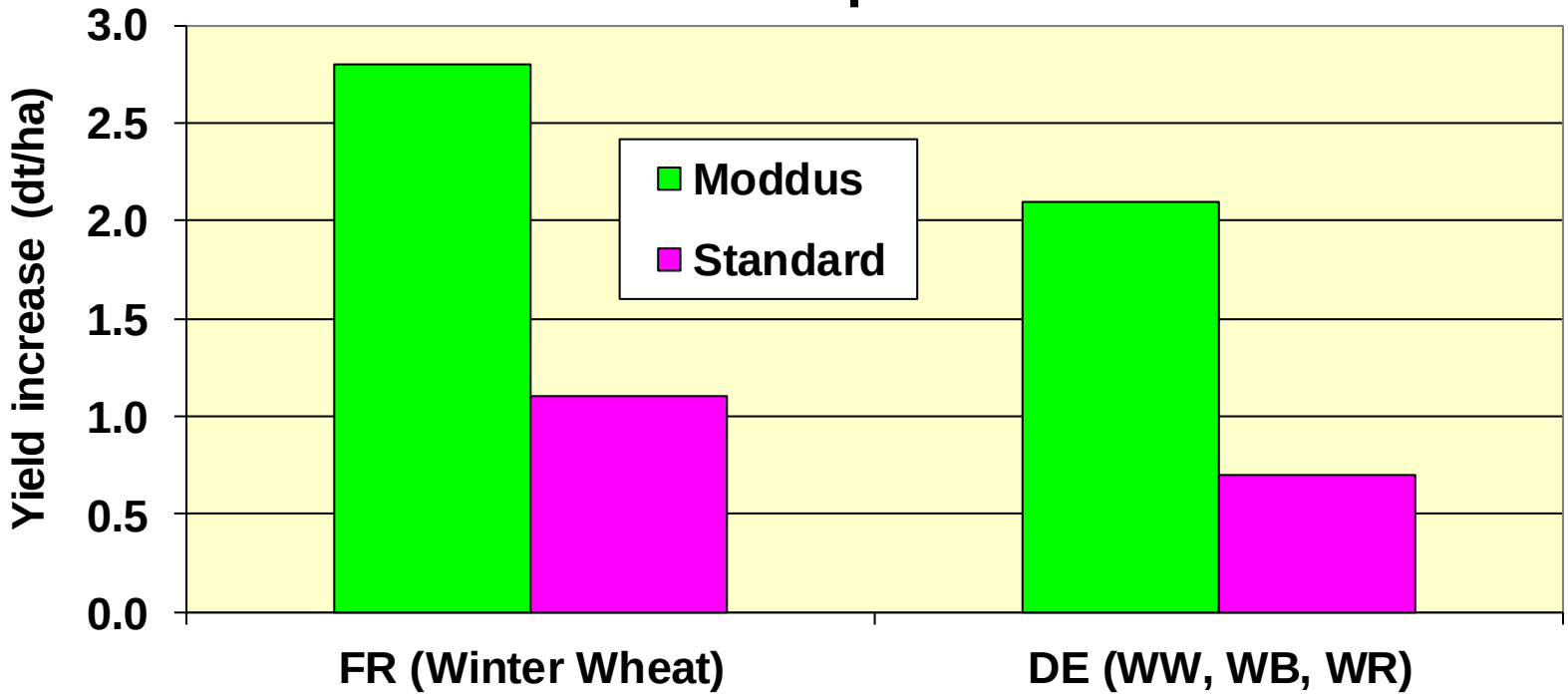
Moddus : 0.5 L/ha

Standard: 5 C (2 L/ha)

Germany

215 trials, 1993-2001

Average of all types of grain
Application rates: according to culture
(recommended application rate / timing



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Lodging control and yield protection

Pete Berry. ADAS UK.

'small or modest sized effects on some characteristics are predicted to have substantial effects on lodging resistance, e.g. increasing **stem diameter by 0.13 mm or root plate spread by 2 mm** is predicted by our lodging model to increase the varietal lodging resistance score by one point'

(1-9 scale where 9 is strong)

Berry et al. (2003) ' A calibrated model of wheat lodging compared with field measurements. Agricultural and Forest

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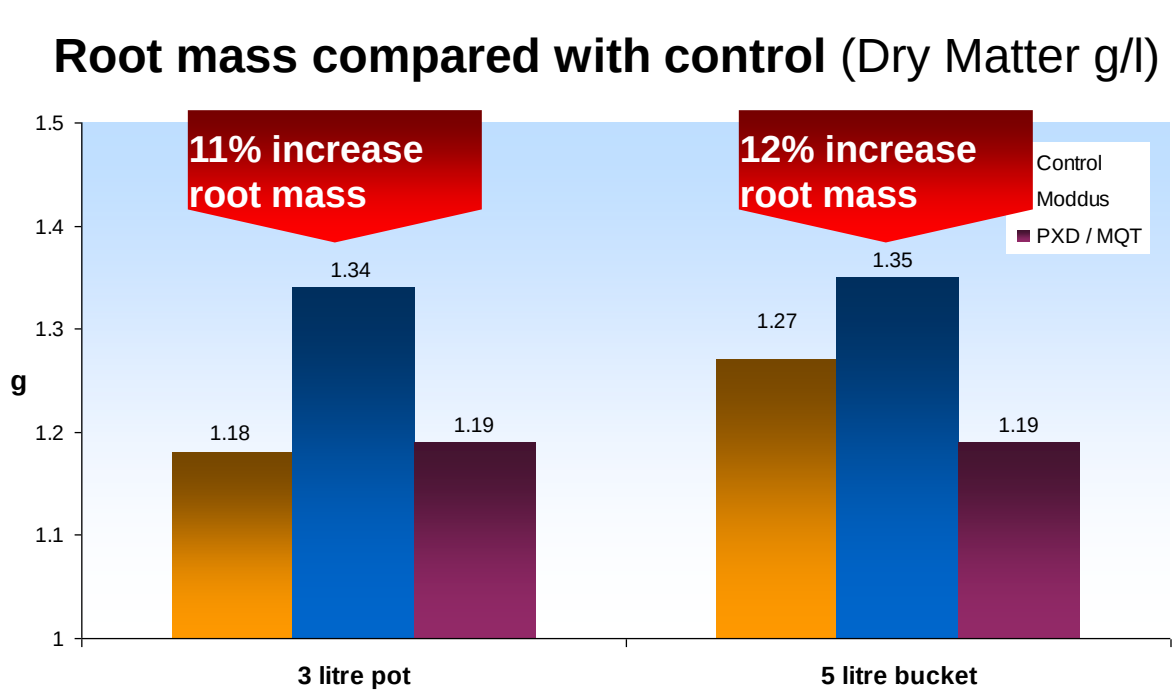
Rooting effects

Root strength and water/nutrient extraction

T0(T1) GS25-30(-32)

MODDUS increases root mass

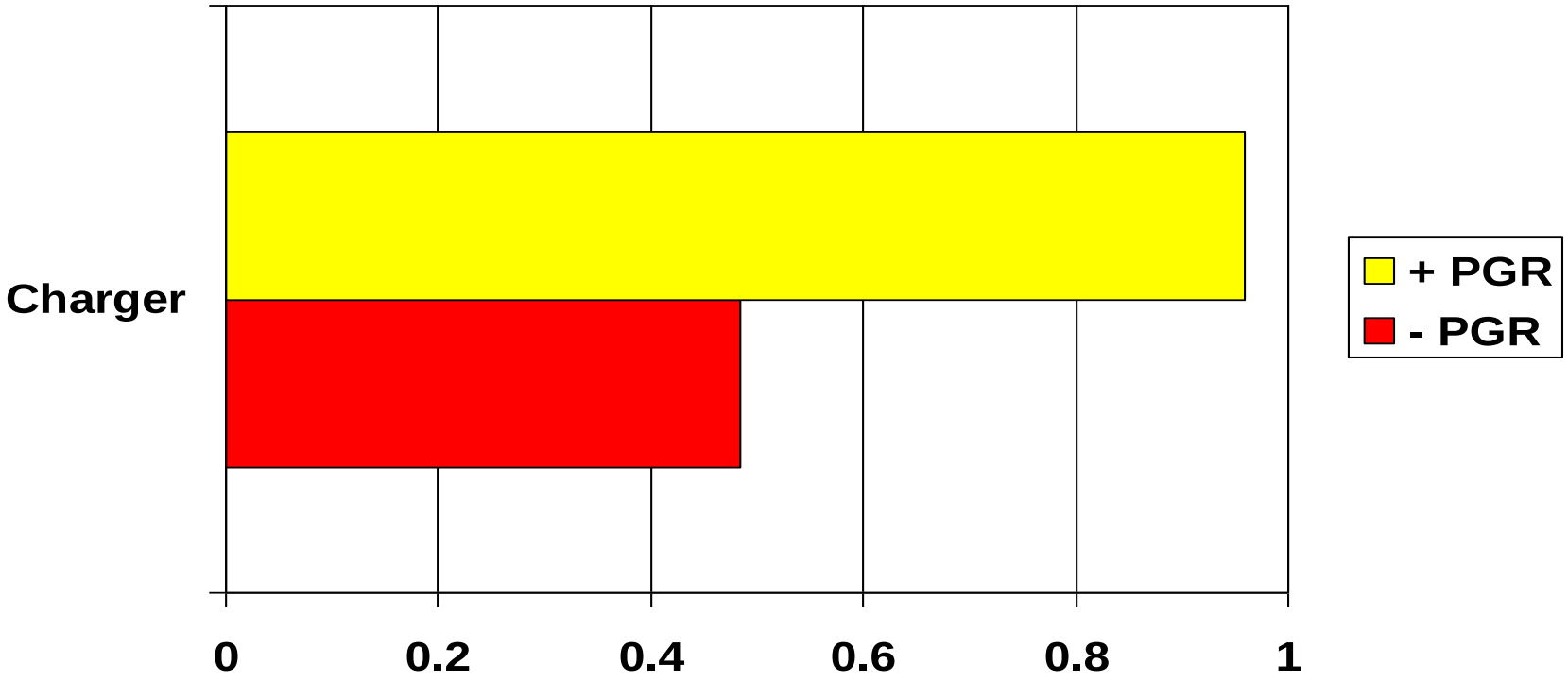


Source: Fachhochschule Osnabrück University, Germany
2006 Outdoor container trial
MODDUS = 0.3LMODDUS+0.5L CCC GS31
0.75L PHD+MQT + ammonium sulphate

MODDUS – rooting effects

Force required to break crown roots/rotate root ball

EFFECT OF MODDUS 0.2l/ha T0 ON ANCHORAGE STRENGTH (Nm)



Source: HAUC Variety Profiling

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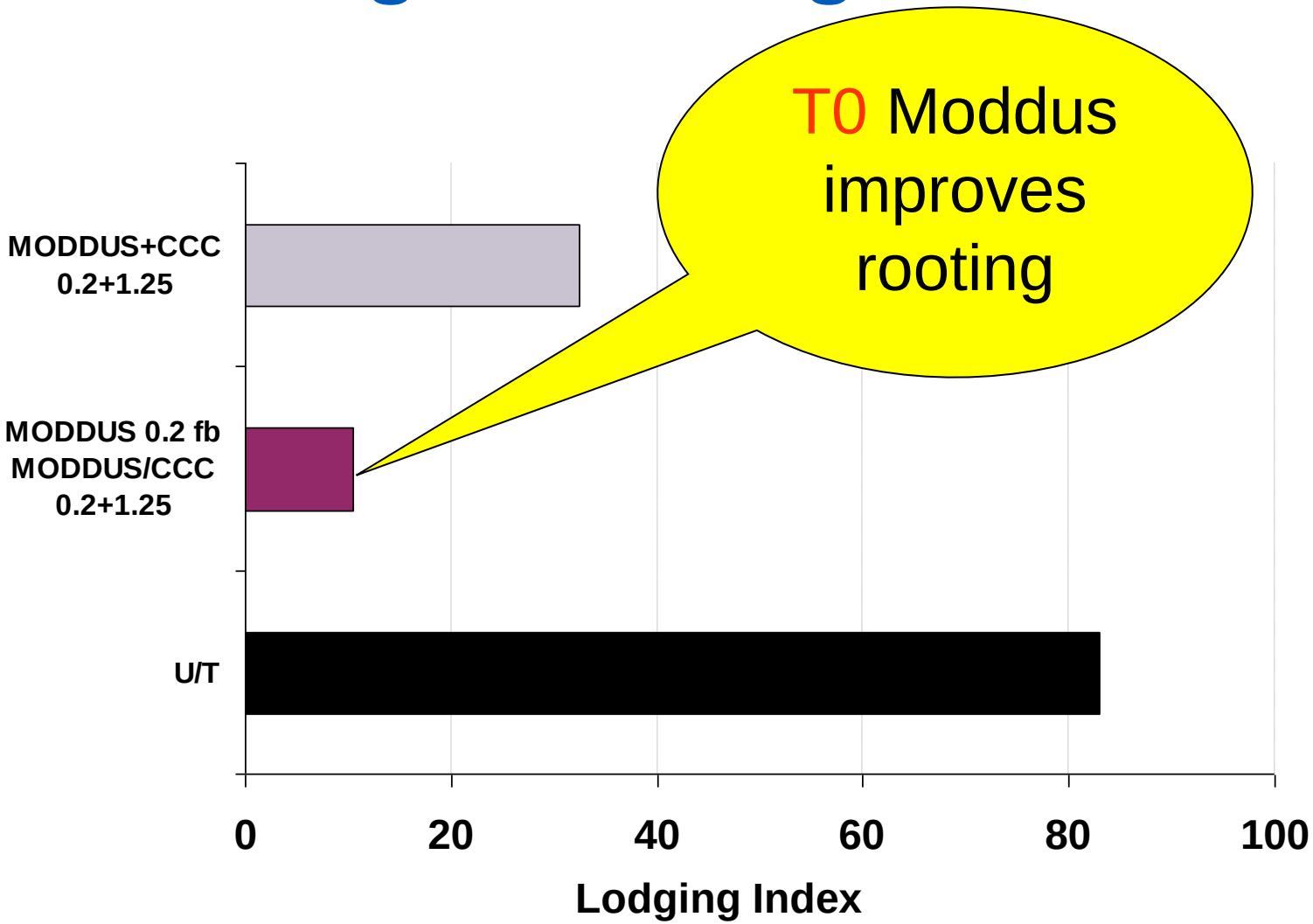
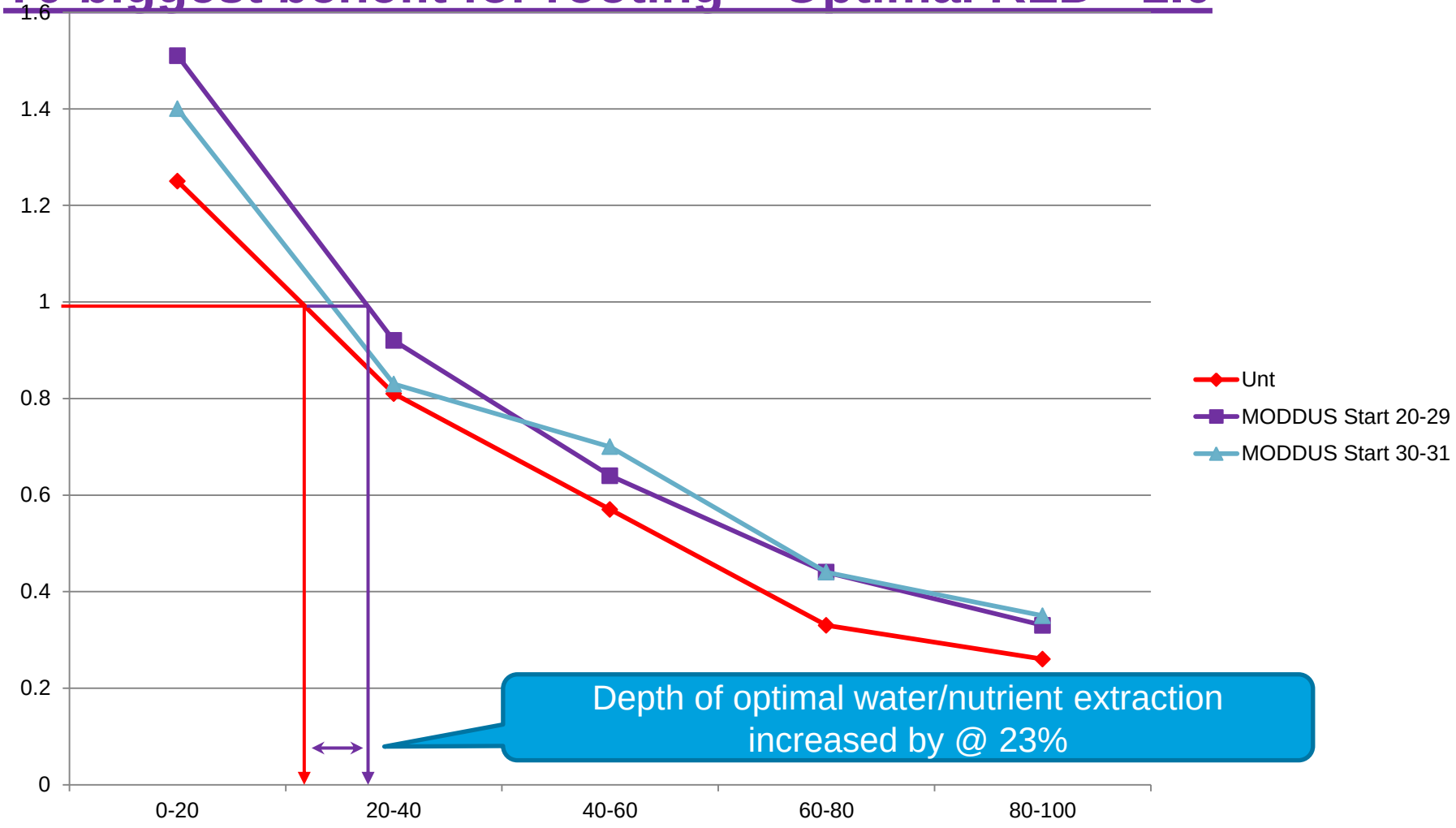
T0 control of root lodging in irrigated Charger…



Application: GS 29-30(March 16th),GS31-32(April 19th)
Source : Syngenta

MODDUS Start effect on root length density (RLD) cm/cm2
ADAS UK 2013 – Av 3 sites
T0 biggest benefit for rooting – Optimal RLD >1.0



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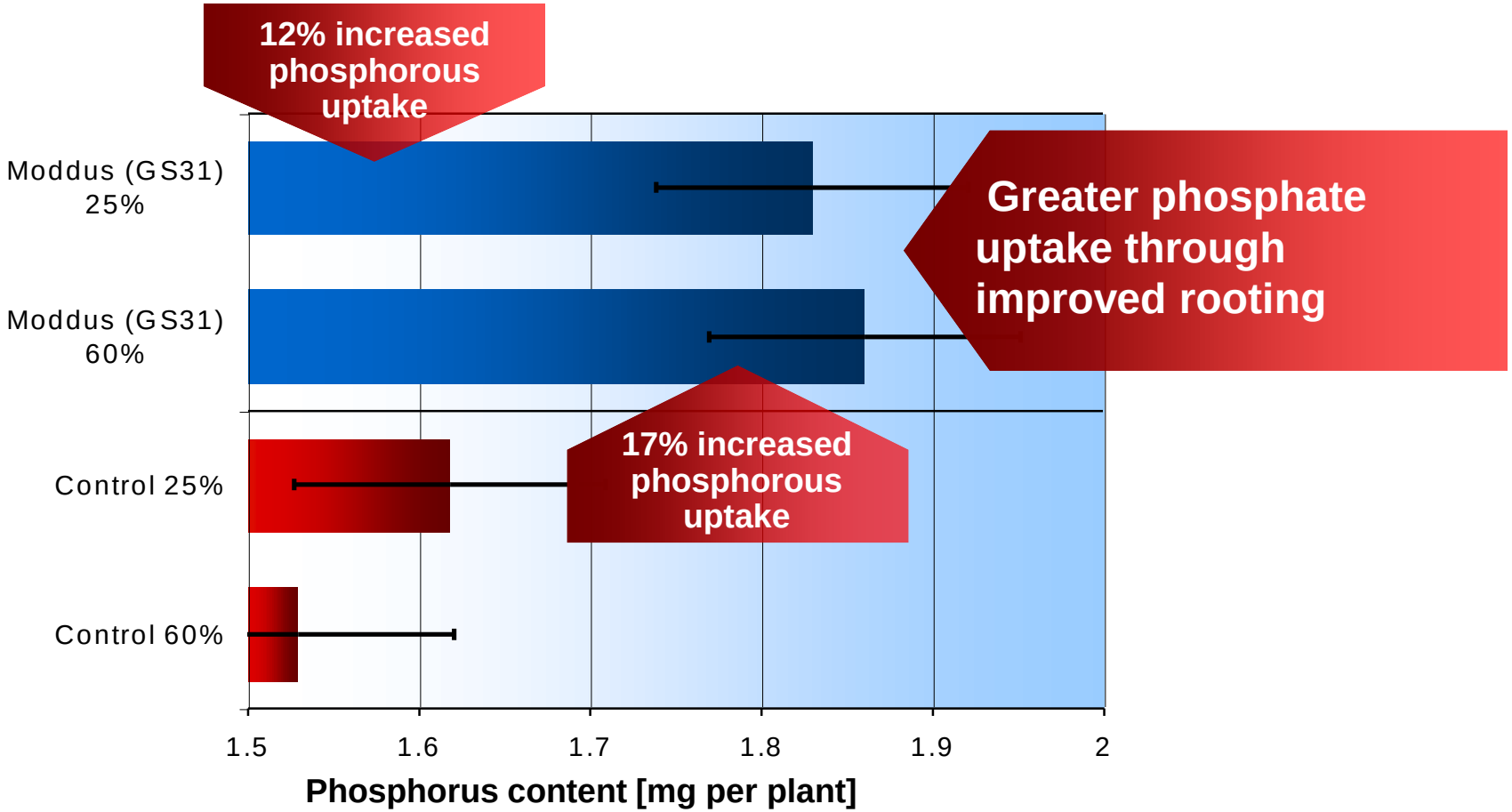
Prof S Schubert
University of Geissen, Germany
Large container experiements 2006

Phosphate scavenging in winter wheat.
P is essential for optimum photosynthesis and yield

Extra roots mean better phosphate uptake



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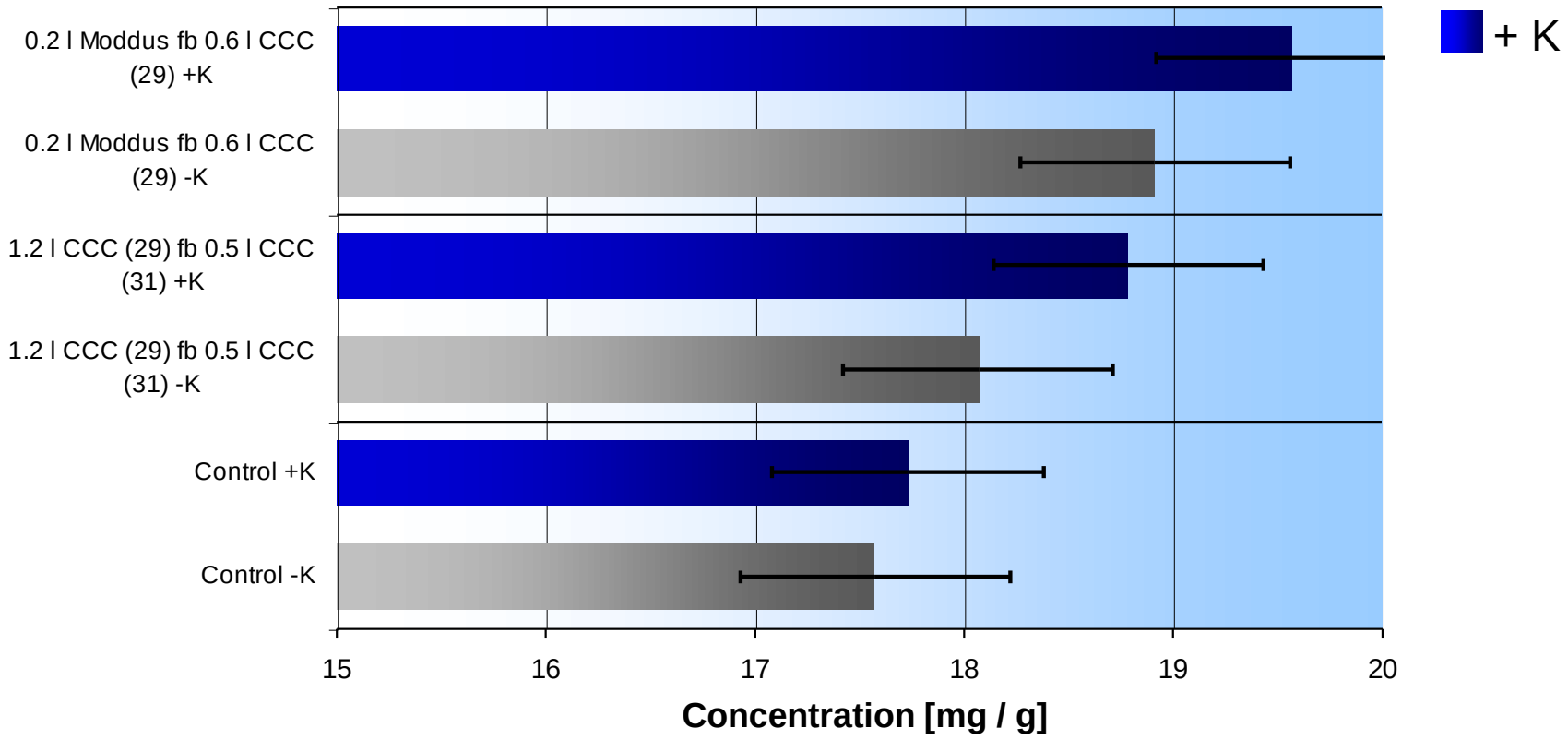
Field experiment Germany 05.05.2006 GS31

With and without potassium (K)

- **Control**
- **1.2 l CCC GS29 fb 0.5 l CCC GS31**
- **0.2 l Moddus + 0.6 l CCC GS29**

MODDUS improves K utilisation



Prof S Schubert
University of Geissen, Germany
Large container experiements

Water use efficiency in winter wheat

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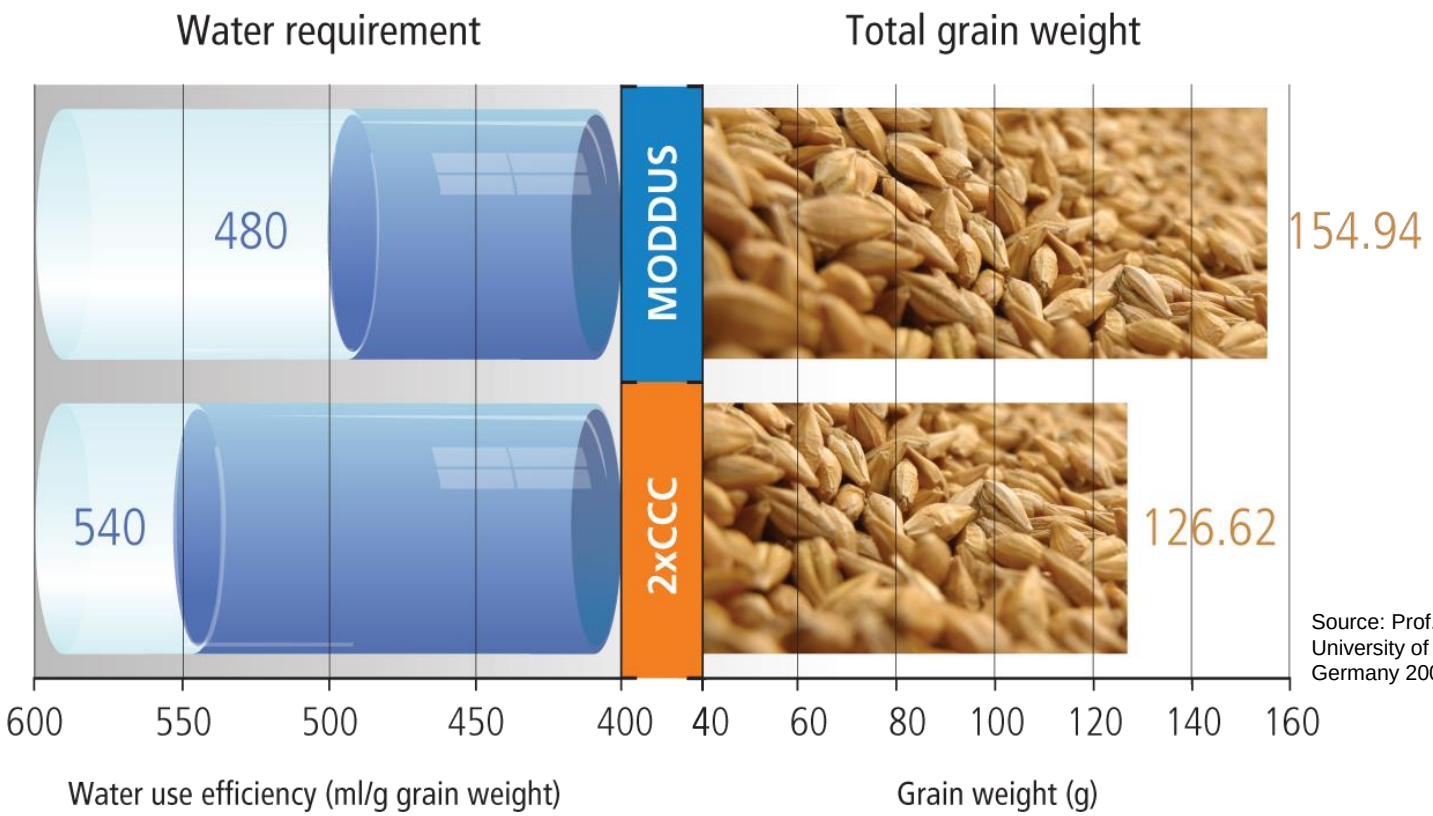
Efficient water utilisation for yield in dry conditions



Source: Prof. S. Schubert, University of Giessen Germany 2004

- DRY' (30% water capacity) conditions maintained for studying effect of PGR on water acquisition and use efficiency
- MODDUS 0.4 l/ha GS31
- 5C 1.2 l/ha GS29 fb 0.5 l/ha GS31

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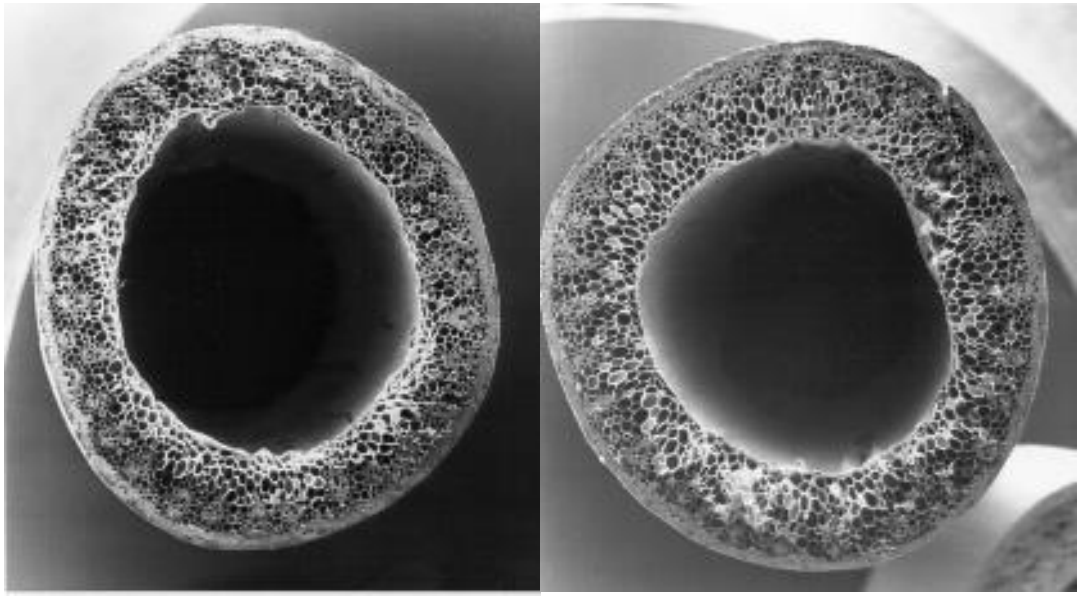
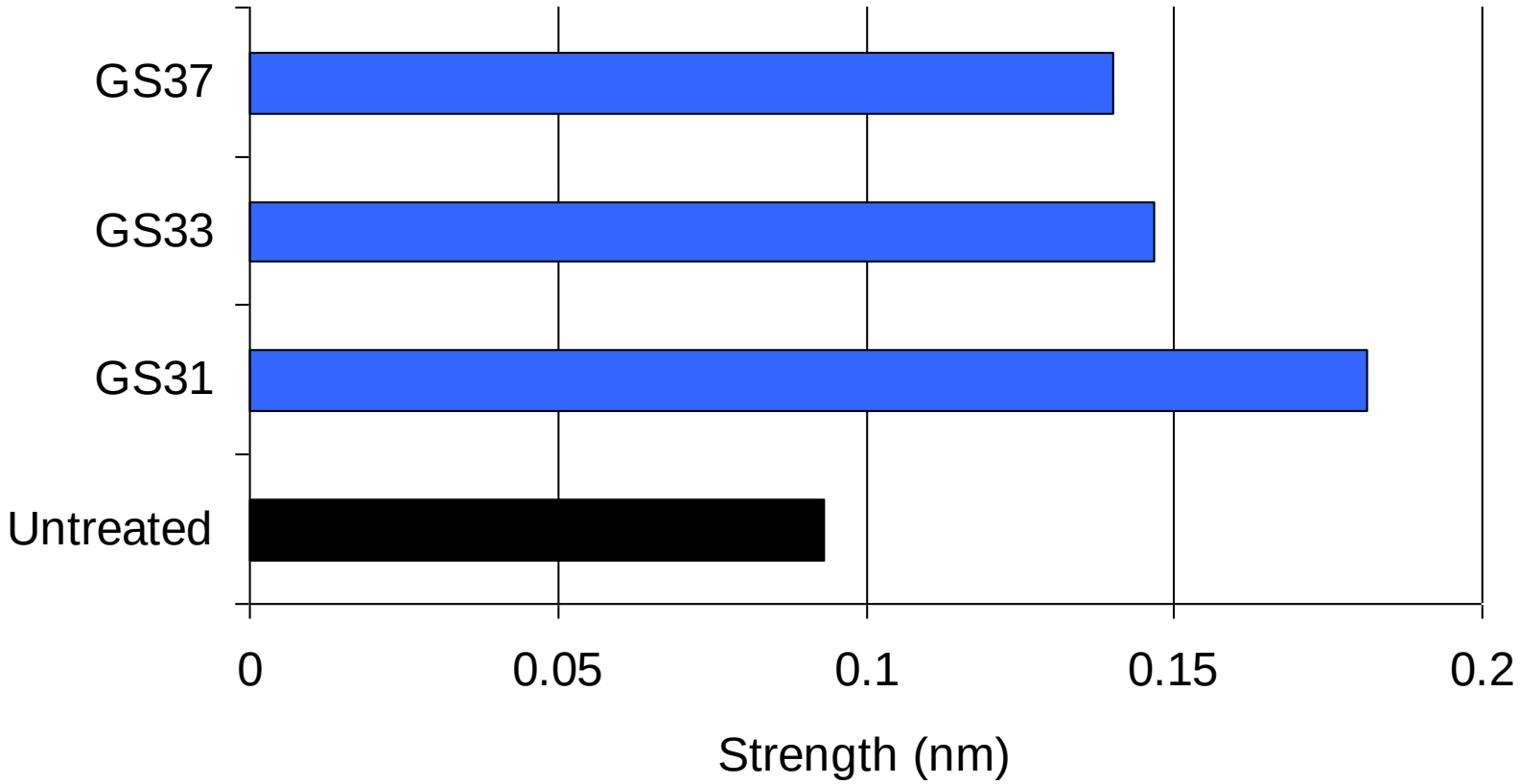
Stem base effects

T1 (GS31-32)



MODDUS - timing and stem base effects

Application at early stem extension gives best stem strength.



Source: Syngenta
Variety: Equinox
MODDUS 2001-2

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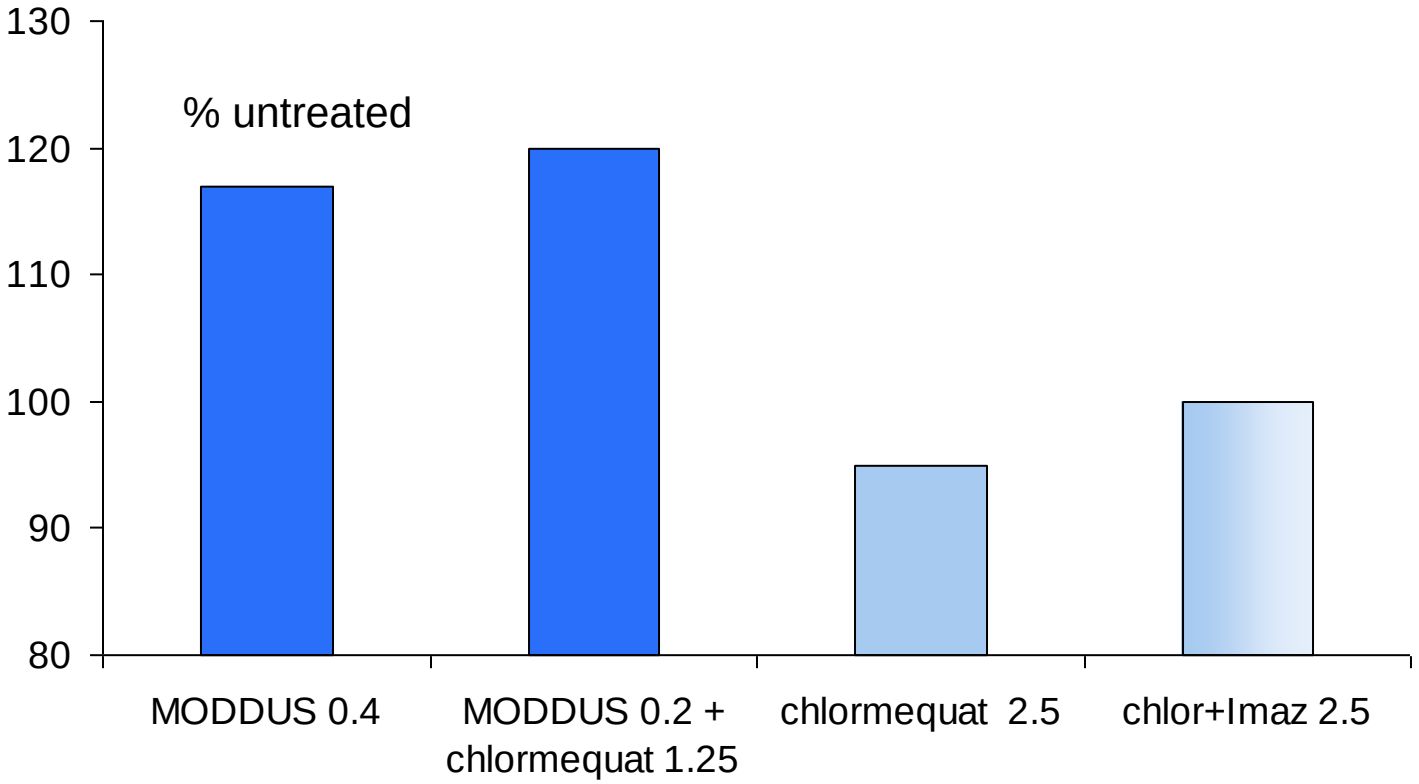
MODDUS - improves stem base strength

Force needed to buckle internode 1 (Nm)



Source : Silsoe College Application GS 31 (n=4)
MODDUS 2001-2

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Impact on height in Denmark spring 2015

0,25 Moddus Start + 0,5 CCC

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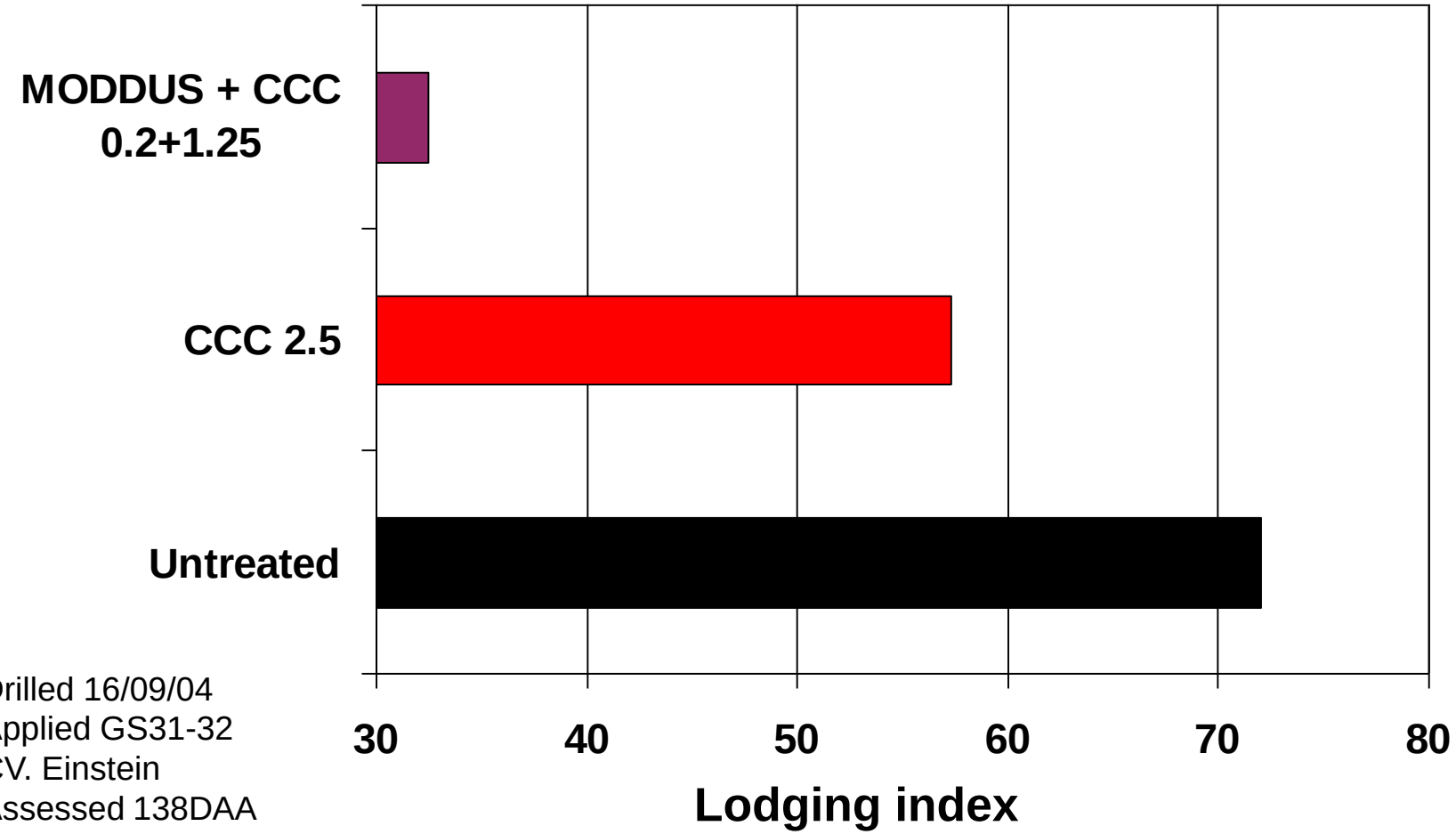
MODDUS - Less stem lodging

Winter wheat cv. Einstein 2005



Drilled 16/09/04
Applied GS31-32
CV. Einstein
Assessed 138DAA

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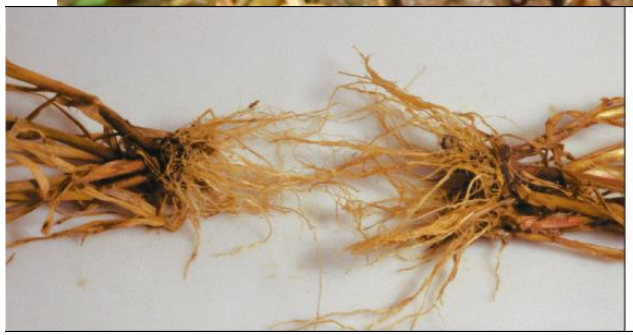
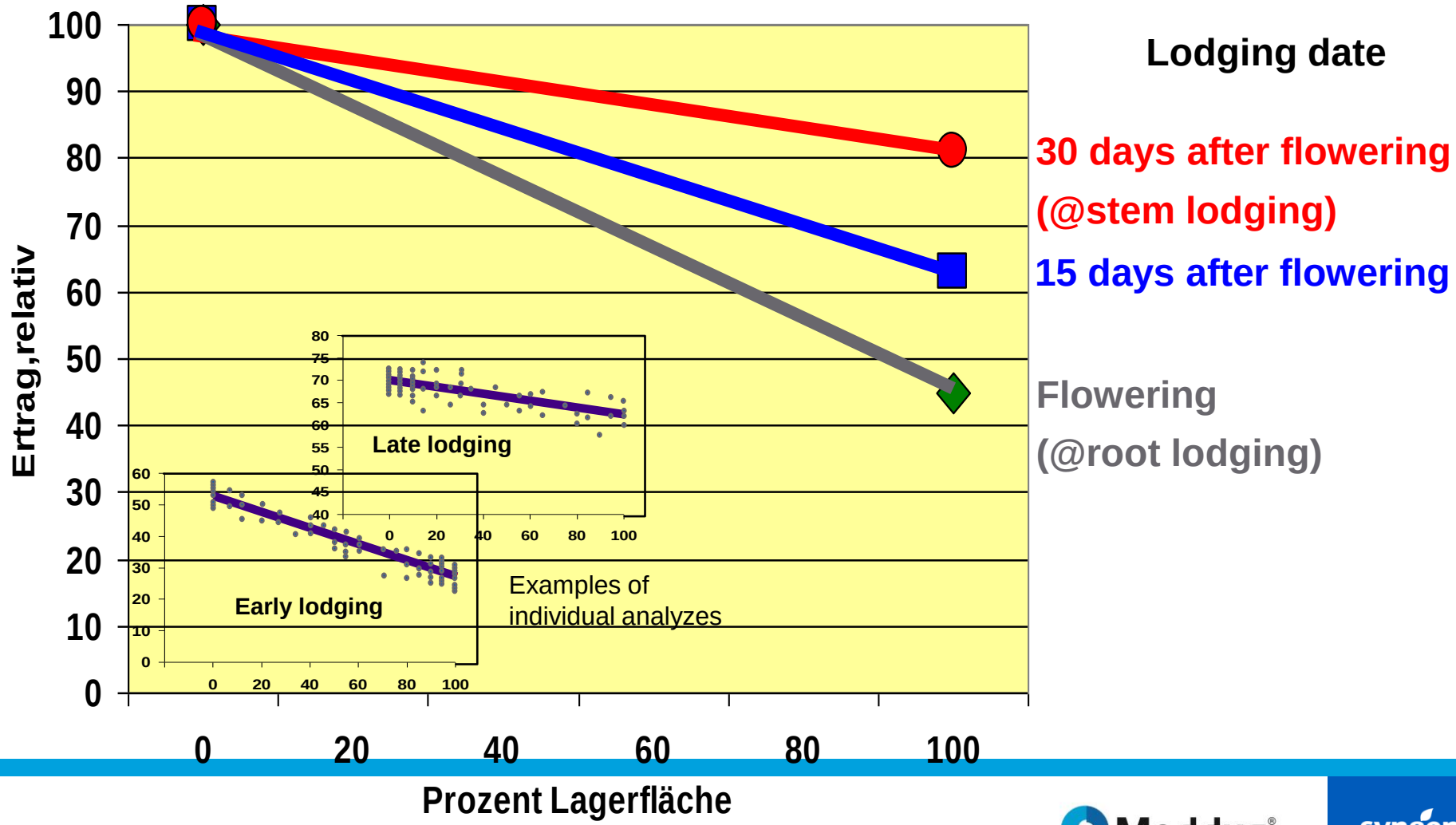
Root and stem lodging



Relationship between lodging area/timing and yield loss

>1500 tests in Germany



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- **MODDUS Start**
  - **Built on 20 years of Syngenta TXP 'know-how'**
  - **Designed to maximise performance and benefits.**

MODDUS Start

New MODDUS technology from Syngenta

Moddus® Start

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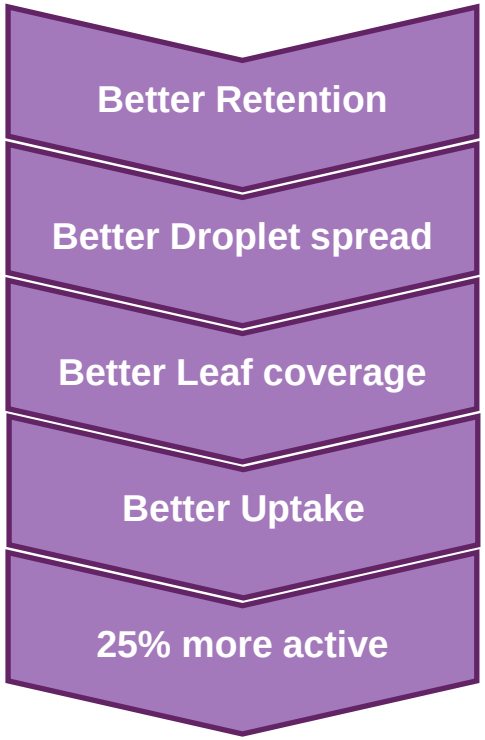
™

PGR timing and benefits

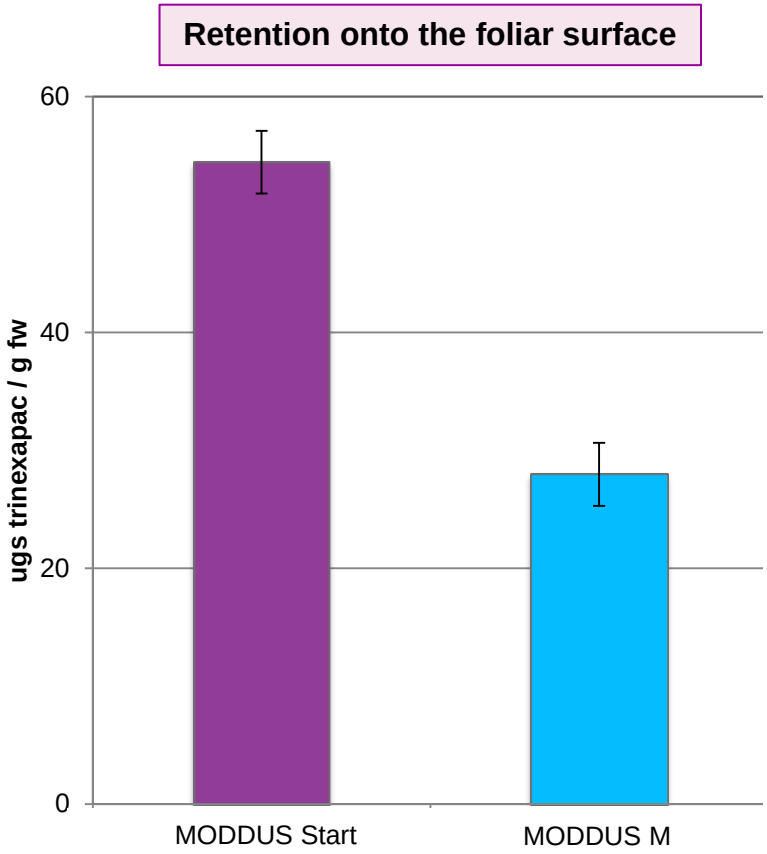
COLD — WARM

PGR impact	T0 (Moddus® Start)	T1 (Moddus® M)	T2
Increased tillering Increased tiller retention	Improved winter hardiness Improved yield potential		
Improved rooting	Improved water and nutrient scavenging Improved drought tolerance Improved fertiliser use efficiency Reduced root lodging = yield protection		
Greening Increased chlorophyll content Longer green leaf retention	Stable photosynthesis Greater sugar production Increased yield potential		
Thicker stem base	Reduced stem lodging = yield protection Increased stem sugar reserves Increased yield potential		
Reduced height	Reduced lodging = yield protection Improved harvest index More photosynthate for yield Increased drought tolerance		
Reduced 'necking' (Ear loss pre harvest)	Yield protection		

How does MODDUS Start work?

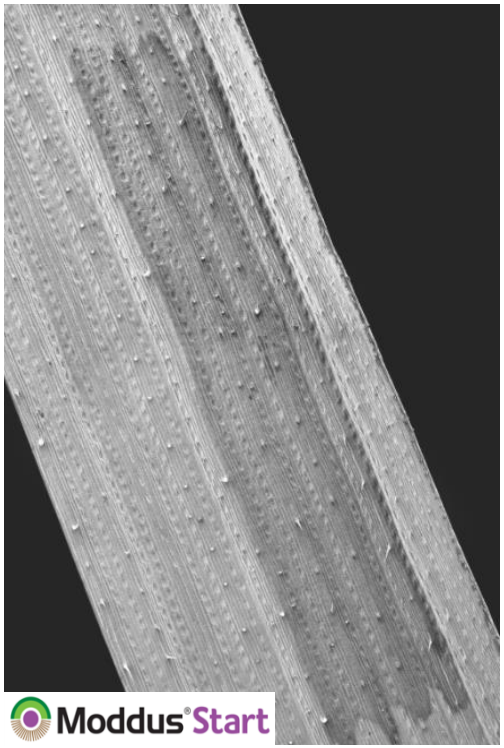


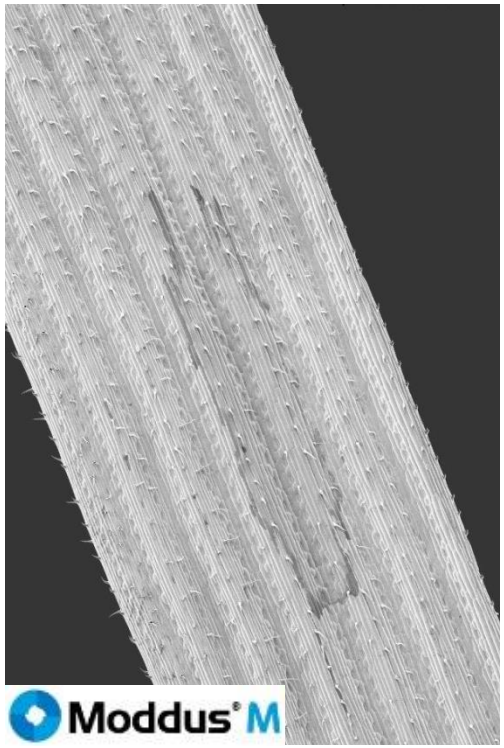
MODDUS Start – Better spray retention on smaller plants (75gai/ha, 0.3l/ha)



Source : D.Bartlett and A.Stalker (Jealott's Hill). Outdoor grown Winter wheat GS30

MODDUS Start – Better droplet spread (75gai/ha, 0.3l/ha)



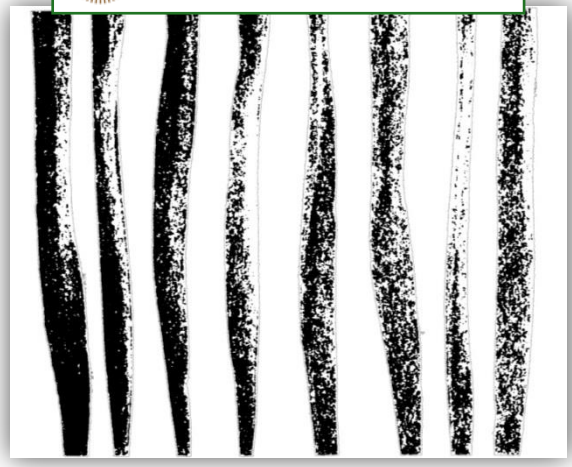


Scanning electron micrographs (SEMs)

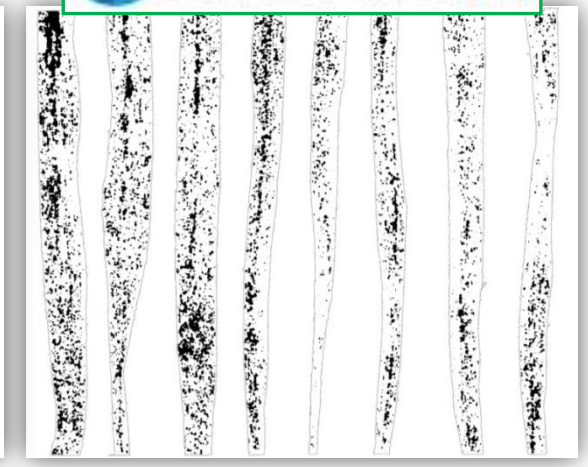
Methodology :
Dried 0.2µl droplet applied to adaxial surface of wheat.
Source :Jill Founding, D.Bartlett and A.Stalker (Jealott's Hill)

MODDUS Start – Better coverage on small plants (retention + spread) (75gai/ha, 0.3l/ha)

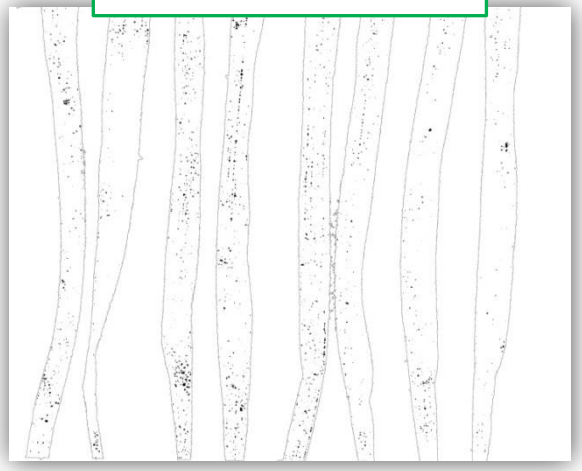
Moddus® Start

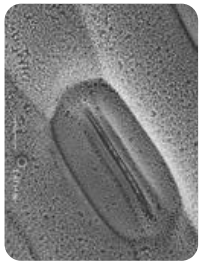


Moddus® M



Water + Tracer



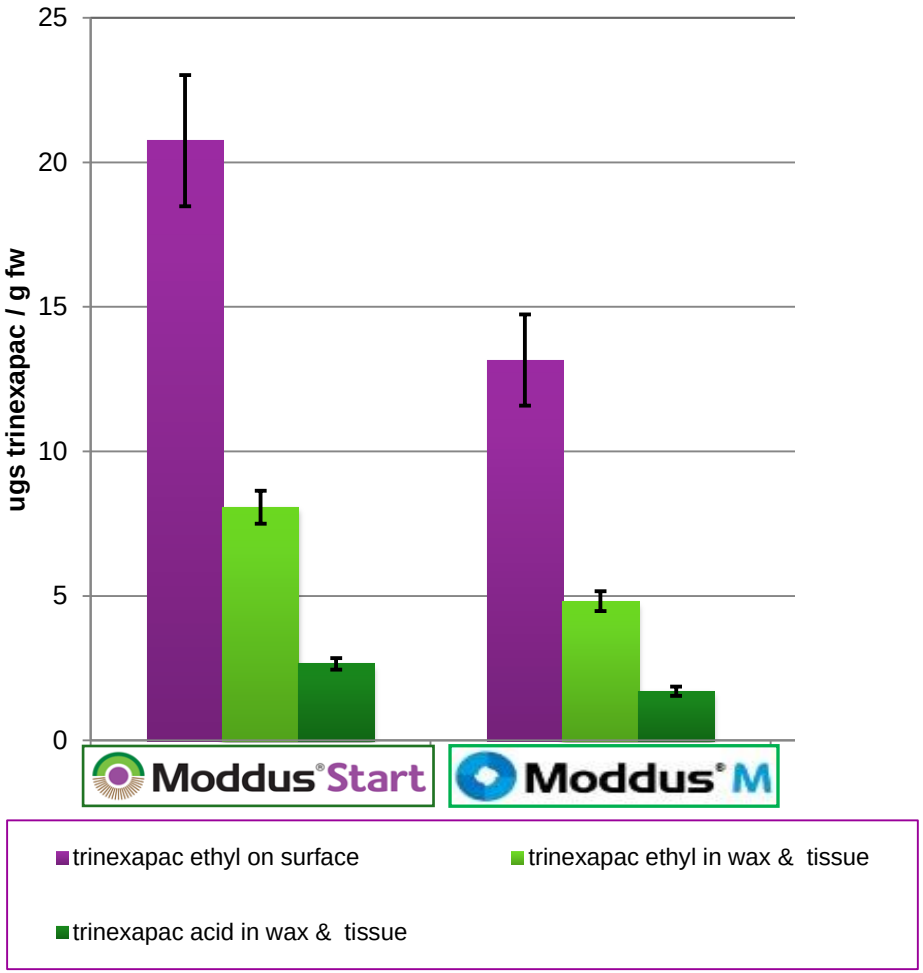


Source : Alan Cochran, Colm Crean, Rob Lind, Anne Stalker (Jealott's Hill).

Outdoor grown Winter wheat, cv Glasgow GS30 – UV tracer image analysis.

Vertical Flat fan nozzle track sprayer application

MODDUS Start – Better uptake of ai on small plants (75gai/ha, 0.3l/ha)

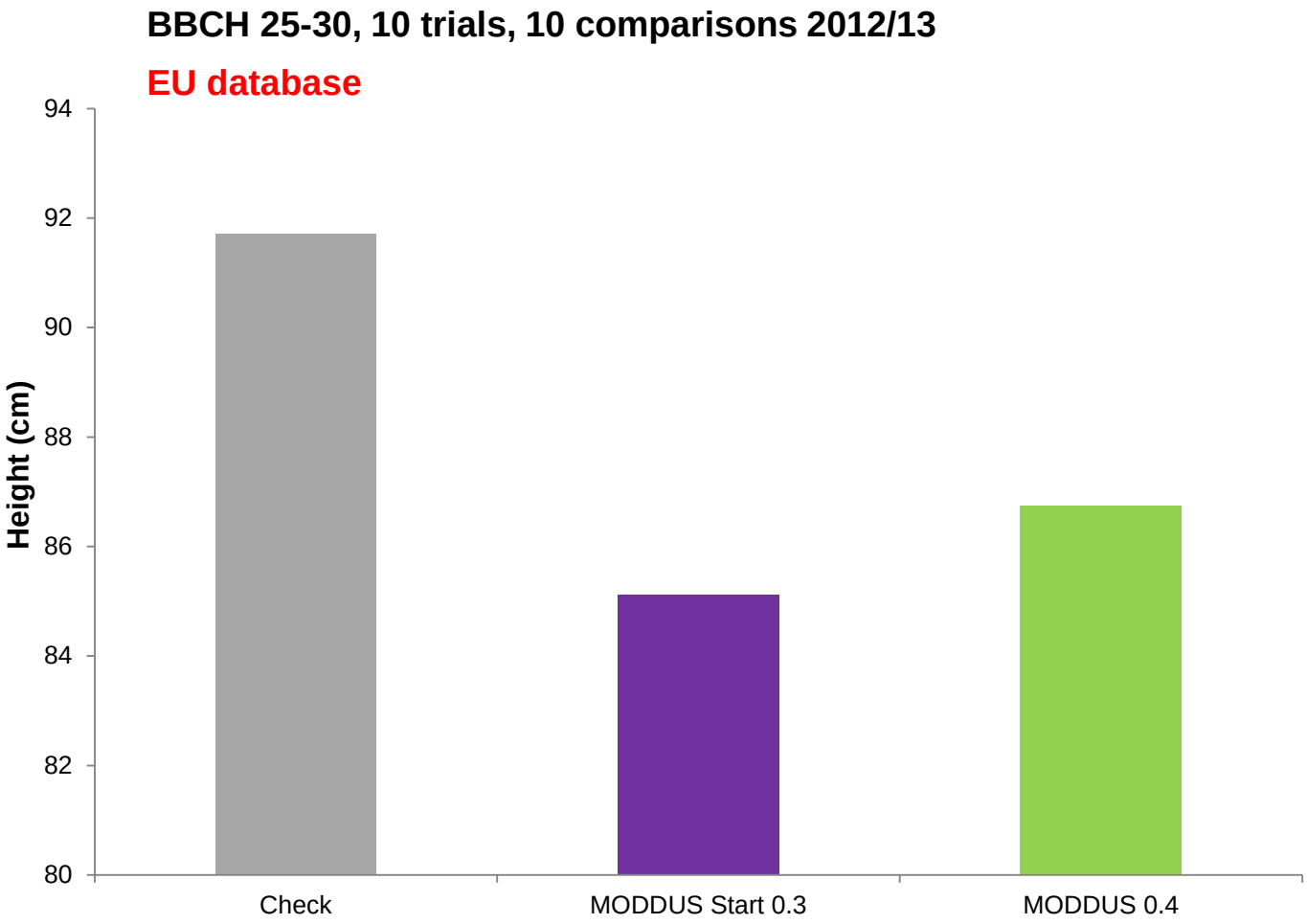


3 hours after application on the leaves.

Source : D.Bartlett and A.Stalker (Jealott's Hill)

Winter wheat, cv Glasgow GS30

MODDUS Start – excellent height reduction in WW
More than 25% efficacy increase

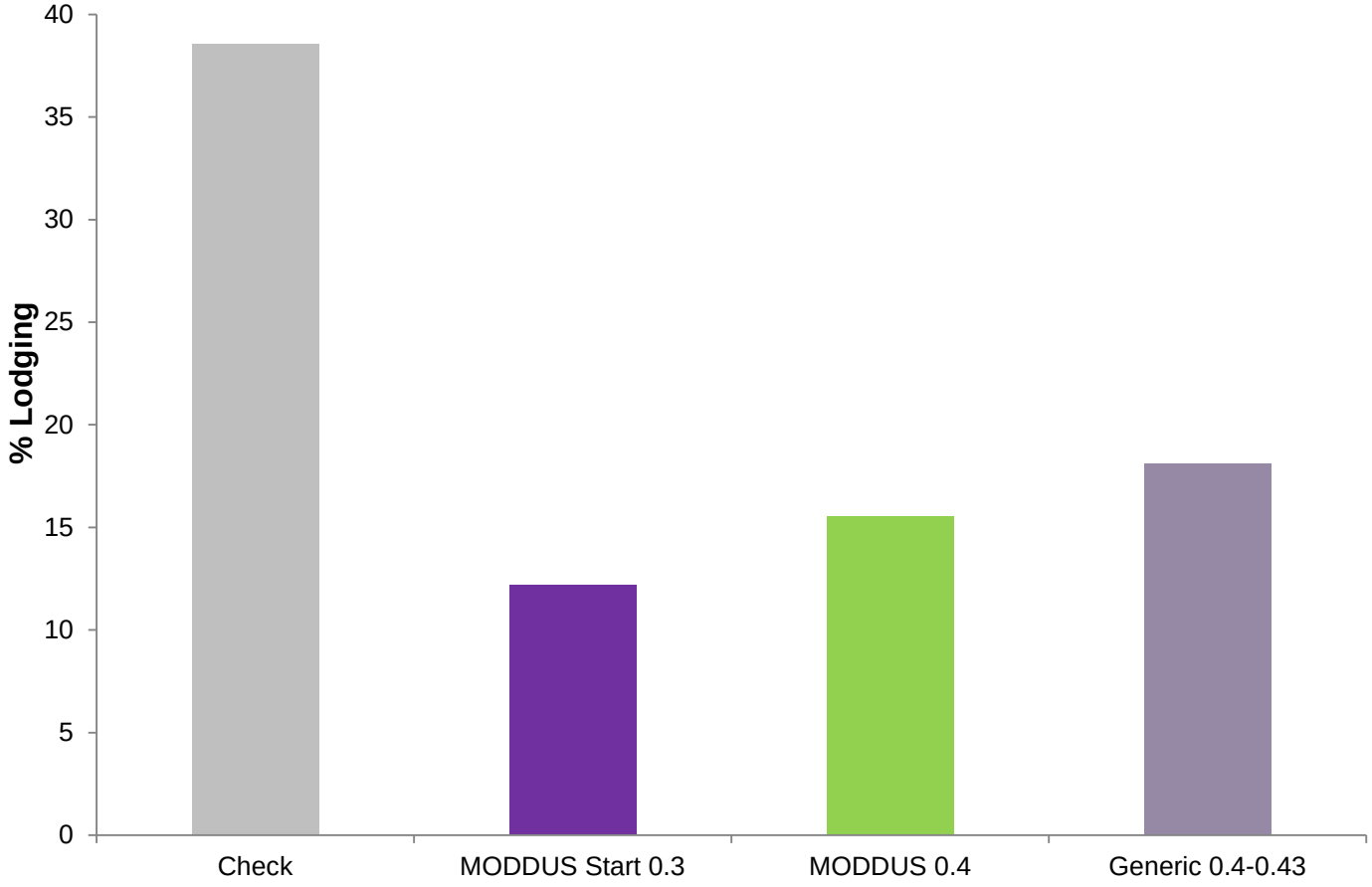


MODDUS Start – excellent lodging control at T0-T1

More than 25% efficacy advantage

(10 trials, 16 comparisons, BBCH 25-32, 2012-2013)

EU database – trial series 2



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Nordic efficacy in WW
Crop greening in Denmark

Moddus®

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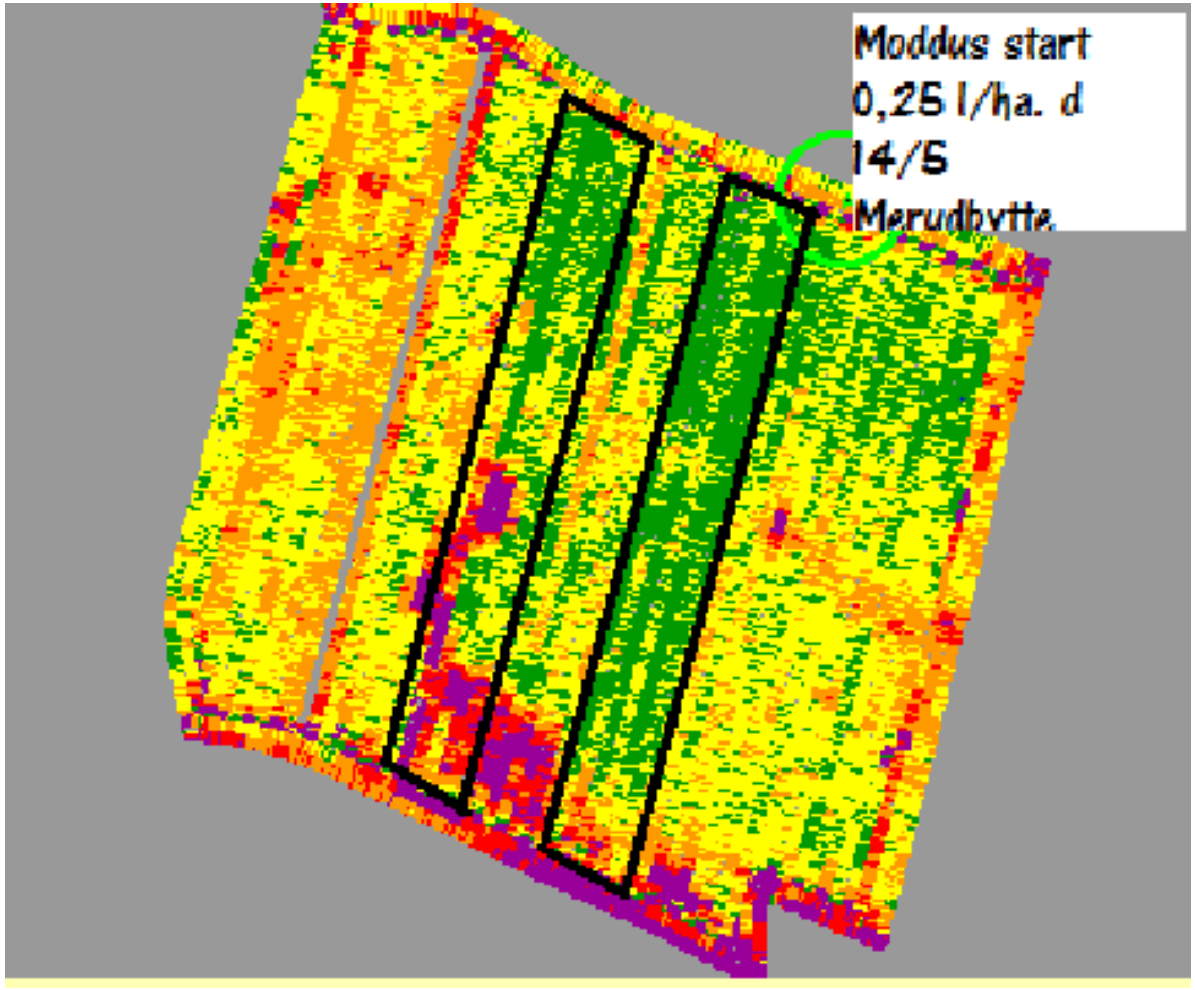
DK spring barley
0.18t/ha yield increase – no lodging



Moddus® Start

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Overall Conclusions

- Active growth is key to PGR efficacy
  - Without it there is no growth to regulate and no need for a PGR
  - Growth is needed to express the positive effects
  - PGR application to crops that are not growing can exacerbate stress
- TXP has a variety of beneficial physical and biochemical effects on the plant
- The optimum timing for maximum benefit for a particular effect varies
- T0 and T1 applications target different effects on the plant

- PGR's directly affect the crop – so do climatic, agronomic, soil and seasonal factors
- Crop growth regulation for optimum plant structure and performance is a dynamic, in season and field specific activity
- Plan, monitor, adapt