Crop enhancements

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UK-Africa Collaboration for Soil Health and Crop Nutrition

Innovate UK

Current Global Reach

- Commercial
- Registration / Trials
- Production sites

Technology Partners

Intrinsyx Bio

ACC

University of Texas

University of Washington

University of Montana

University of Kwazulu-Natal

Duke University

University of New Mexico

Rothamsted

University of California

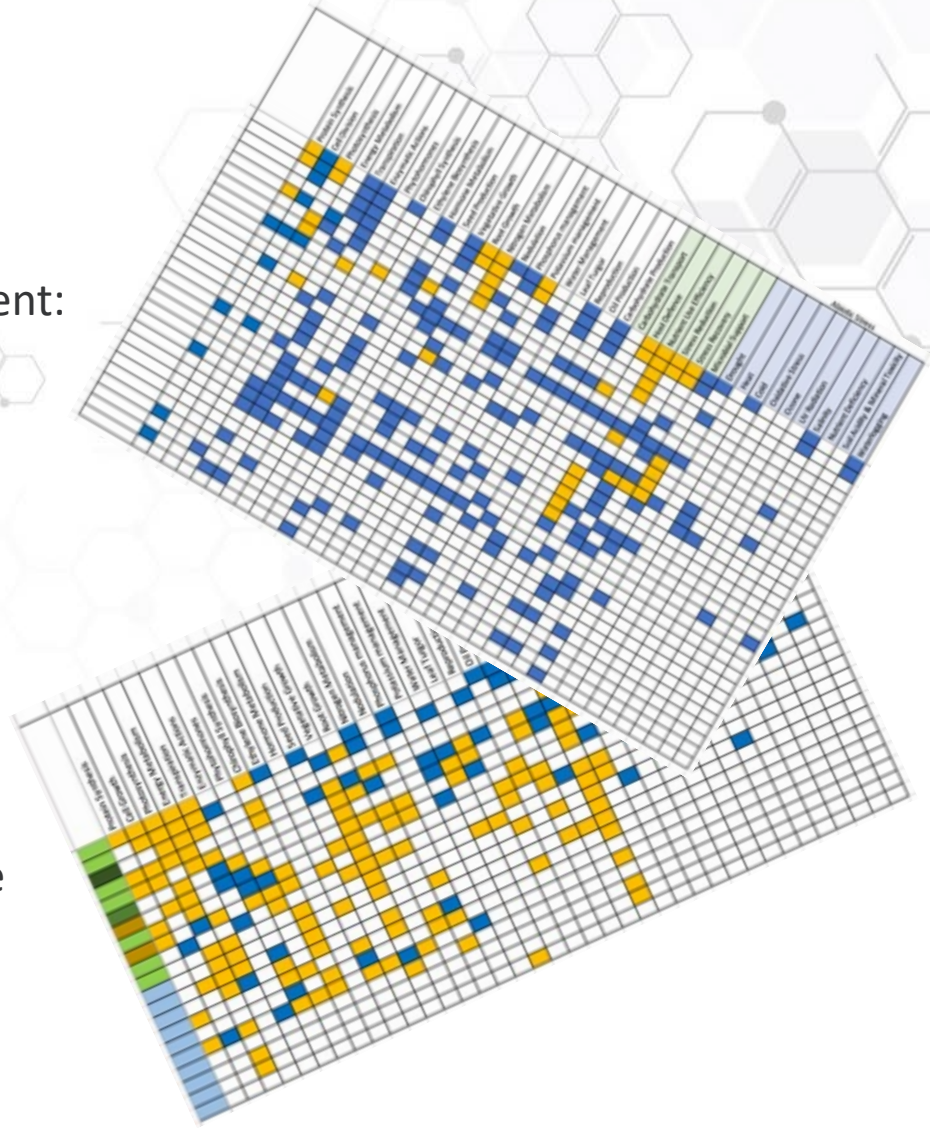
University of Chicago

ACG

Technology Platforms

Key Criteria for development:

- Peer reviewable data
- Proof of concept data
- Field trials
- Soft Chemistry
- Integrateble Affordable
- Practical



Brand Platforms

	Platform	Technology	Brand
	Seed Treatments	Biostimulant Based Technologies	TIGGA, BOOST, SOYUZ, Voltek, VYTA, TETRIS, UNI-CALELIOS
	Biologicals	Endophyte – all crops Inoculants – pulse crops	TIROS, TARBIS, EXSEED
	Metabolites	2 x C3 & 2 x C4 N metabolites 4-oxo chlorophyll boosting metabolite 3 Krebs Cycle metabolites 3 Carbohydrate metabolism promoters - T6P	KLOROFILL, Verda Technology, TWOXO, t6p
	Biostimulants	Potassium and Calcium Phosphite Amino Acids , SAR technologies	aCalsa, HumX, Scyon, KIROL, CALFITE, FulvX PGA
	Nutrient Enhancers	Nitrogen, Phosphorus and Potassium nutrient use efficiency materials	NFINITY, WHOLLY K, LUXOR
	Nutrients	Potassium, Sulphur, Boron and amino acid complexed trace elements	AMINOPLEX
	Adjuvants-Enhancers	Biological Drought Stress Mitigation	tbc

From Concept to Farm Solution

Research and Discovery

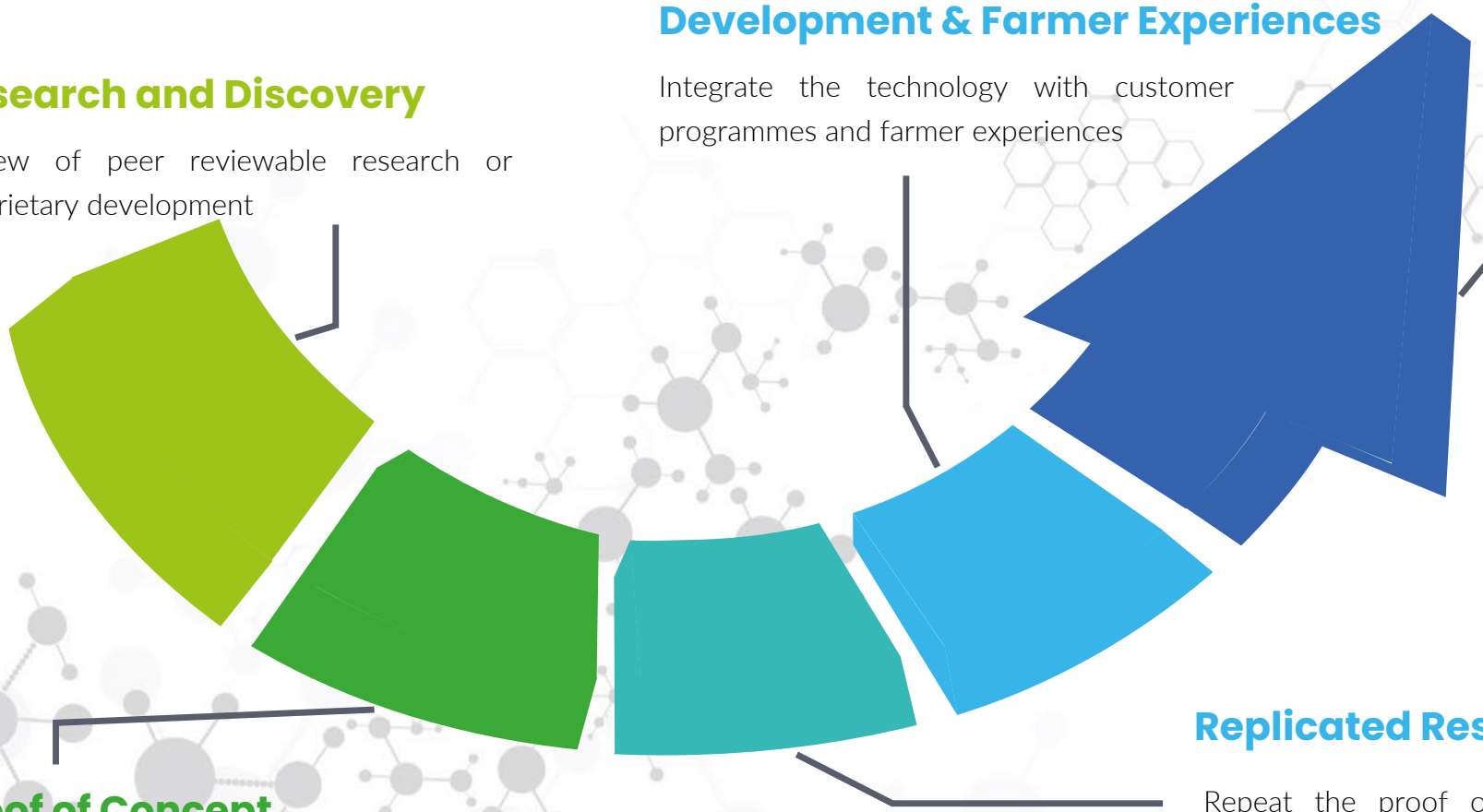
Review of peer reviewable research or proprietary development

Development & Farmer Experiences

Integrate the technology with customer programmes and farmer experiences

Launch

After a minimum of 2 years data plan for launch



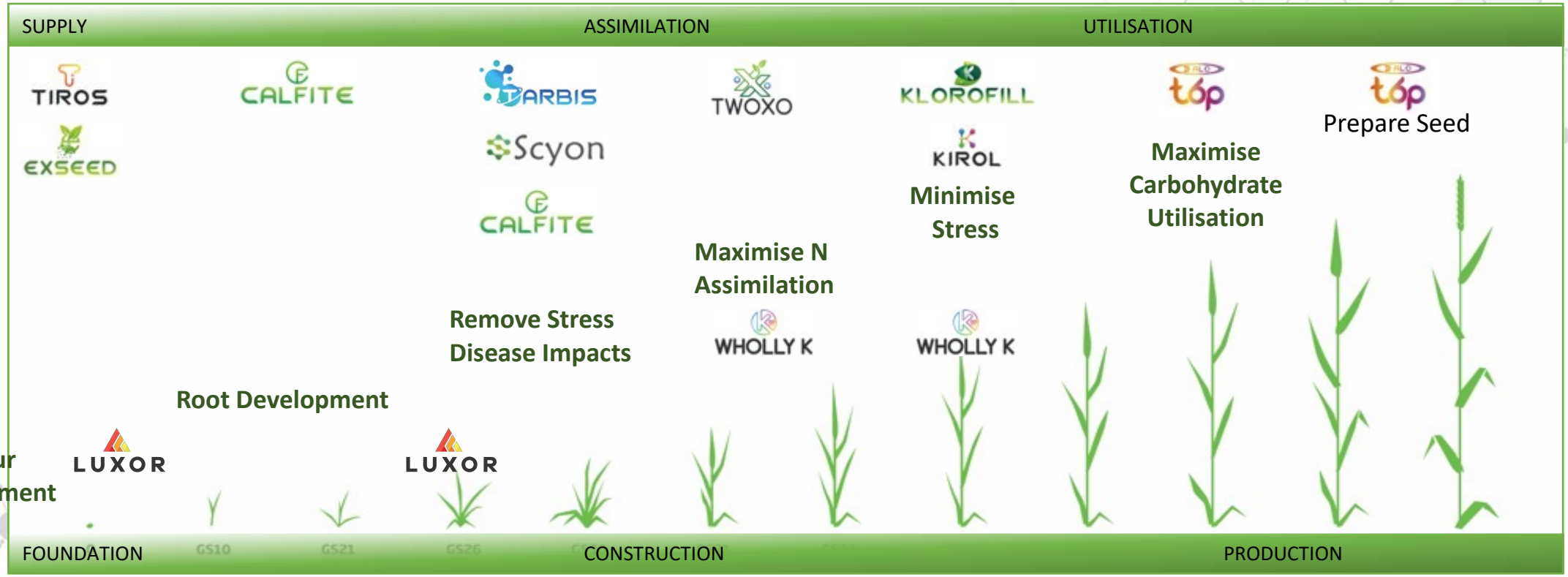
Proof of Concept

Working with leading Institutes to prove the concept and solution

Replicated Research

Repeat the proof of concept in a field situation

Biological / Biostimulant / Nutrient Opportunities



	T0	T1	T2	T3
	Biological Supply P fertiliser	Foliar fertiliser	Foliar fertiliser	Foliar fertiliser
Fertiliser Coating	FINITY	FINITY	FINITY	

UK Technology Screening

The University of Nottingham

University of Posnan

ROTHAMSTED RESEARCH

University / Institute Proof of Concept

Replicated Field Trials

Replicated plots covering

a. Academy Blocks
b. Programmes
c. T0 Options
d. T1 Options
e. T2 Options
f. T3 Options
g. Biologicals
h. Soil biology priming
i. Trehalose pathway
j. P & K
k. Formulation developments

Products Solutions for Consideration

- Graphite Based Seed Treatment (farmer applied)
- Tarbis – Foliar Bacterial Endophytes for N&P use Efficiency
- Scyon – Nutritional Crop Health
- Twoxo – Nitrogen Assimilation
- 3Alo T6P – Carbohydrate Management

Graphite Biostimulant ST

Experience 2

Cover crop
Day 14

Tarbis

- What is it?
  - A unique consortia of two bacterial endophytes from the University of Washington,
- What does it do?
  - The two strains compliment each other and are designed to fix atmospheric nitrogen and to solubilise and sequester phosphorus for a wide range of crops.
  - They also increase the uptake of other nutrients to help the plant maintain nutritional balance (stoichiometry)
  - Reduce the impacts of abiotic stress and increase the recovery time especially from drought stress.

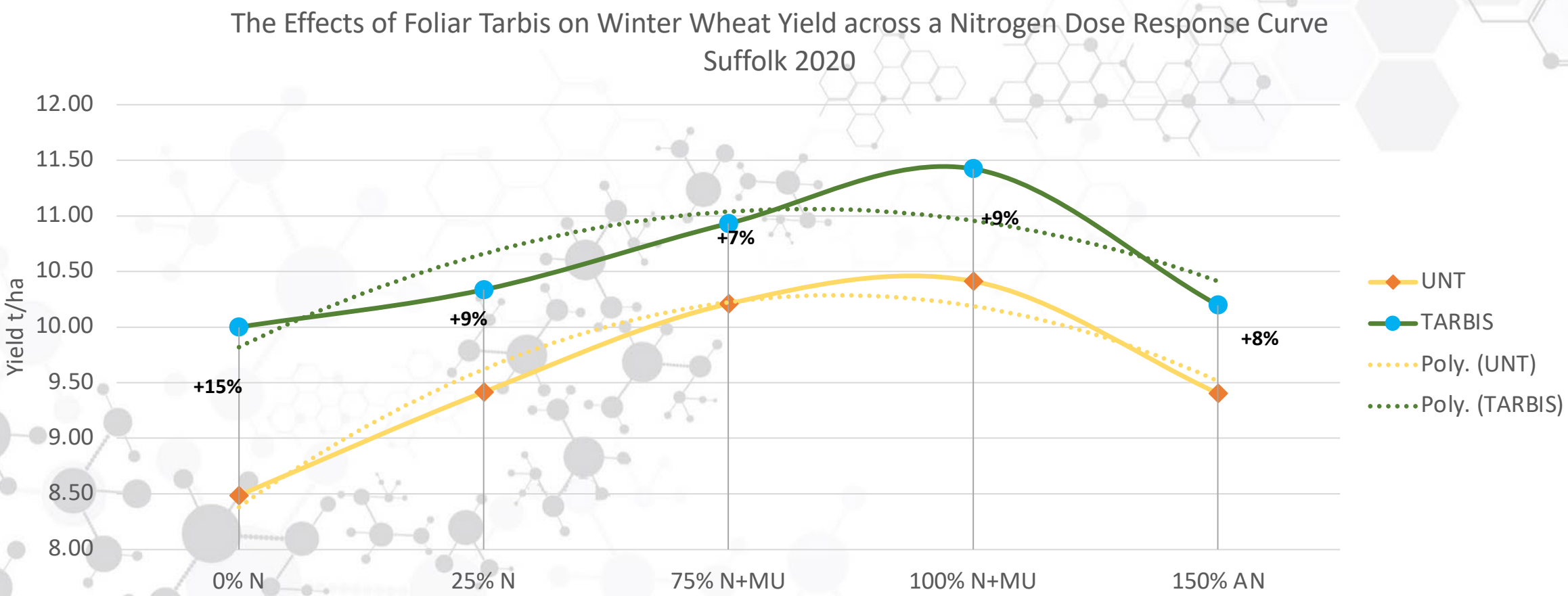
CROP	OPTIMUM TIMING **	DOSE ~ L/Ha
Winter Cereals	GS30	1.0 L/Ha
Spring Cereals	Early to mid tillering	1.0 L/Ha
OSR	Onset of spring growth	1.0 L/Ha
Potatoes *	Meeting along the row	1.0 L/Ha
Sugar Beet	3-6 leaf stage	1.0 L/Ha
Maize *	2-4 leaf stage	1.0 L/Ha
Vegetables	Pre transplanting or early post transplanting	1.0 L/Ha
Grassland	Onset of spring growth or once final cut has been made pre autumn	1.0 L/Ha

- Can be applied in the furrow at planting/drilling

** Can be applied either side of the optimum timing if sufficient crop cover

- How does it do it?
  - The endophytes colonise and move within the vascular system of the plant ensuring full crop coverage very quickly
- Features
  - ✓ Increased root biomass
  - ✓ Increased Nutrient uptake especially N, P and K
  - ✓ Increased N assimilation
- Benefits
  - ✓ Enhanced N supply to the crop and increased assimilation within the crop
  - ✓ Increased phosphorus delivery to the plant at key growth stages
  - ✓ Ability to deliver key nutrients efficiently at key timings
  - ✓ Increased leaf protein
  - ✓ Increased nutrient use efficiency
  - ✓ Increased soil microbial health and biomass
  - ✓ Enhanced Yield / Quality

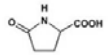
Nitrogen Dose Response Interactions with Foliar Tiros 2020



N = Urea coated with Nutrisphere
MU = methylene urea foliar N

Twoxo

- What is it?
  - A Unique blend of 2 peer reviewed technologies;
  - 2-oxo glutaramate (2 oxo) –the original award winning technology from Dr P Unkefer (Los Alamos National Laboratory) which coodinates a plants nitrogen assimilation with its carbon fixation. Unique to UBS

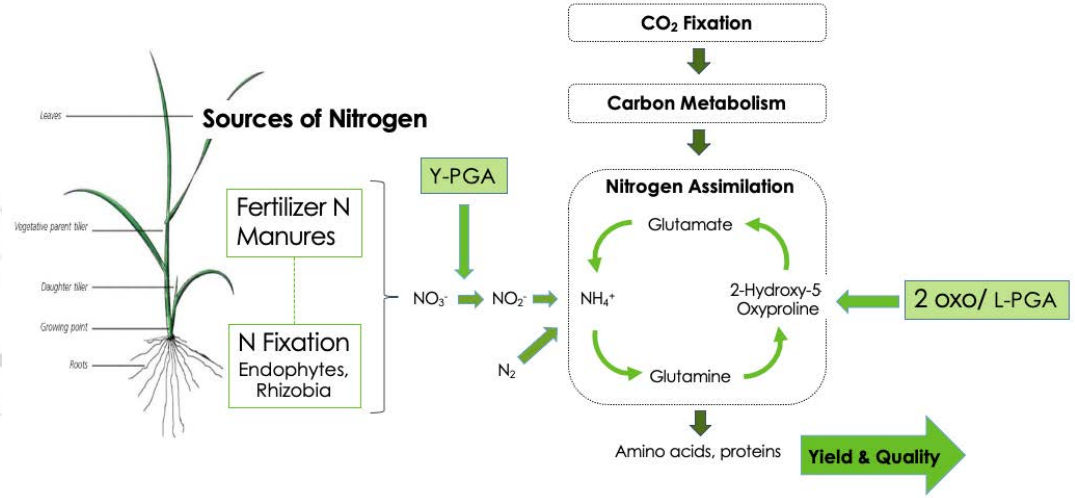


  - L-PGA (Pyroglutamic acid (L-PGA) or Pidolic Acid) – a functional analogue of 2 oxo, it converts in the plant to 2 oxo
- What does it do?
  - The unique combination work synergistically to enhance nutrient use efficiency, increasing the assimilation of nitrogen coordinated with increased carbon dioxide fixation from photosynthesis.
  - It is proven 2-oxo is superior to L-PGA, but the combination outperforms either separately.

CROP	TIMING	DOSE ~ L/Ha
Cereals	GS 30 – 32 (trials optimum GS31) *	1.0
OSR	GB – Mid Flowering (trials optimum *	1.0
Potatoes	Onset & Mid Bulking *	1.0 x 2

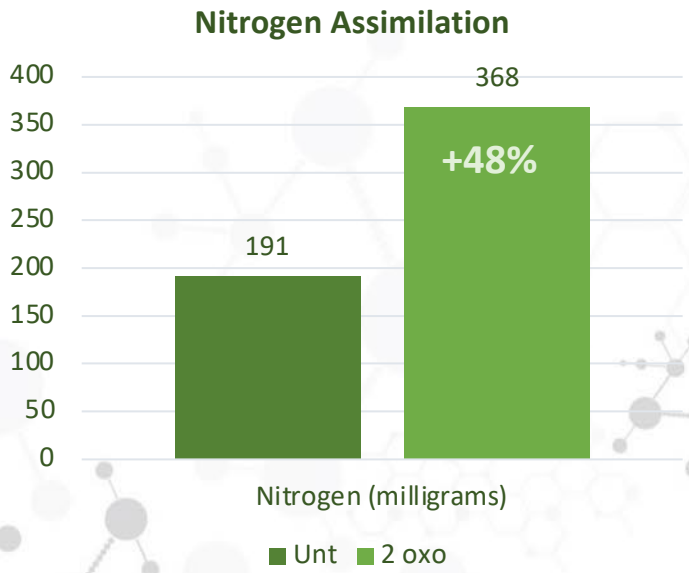
* Can be applied alone or with liquid N fertiliser

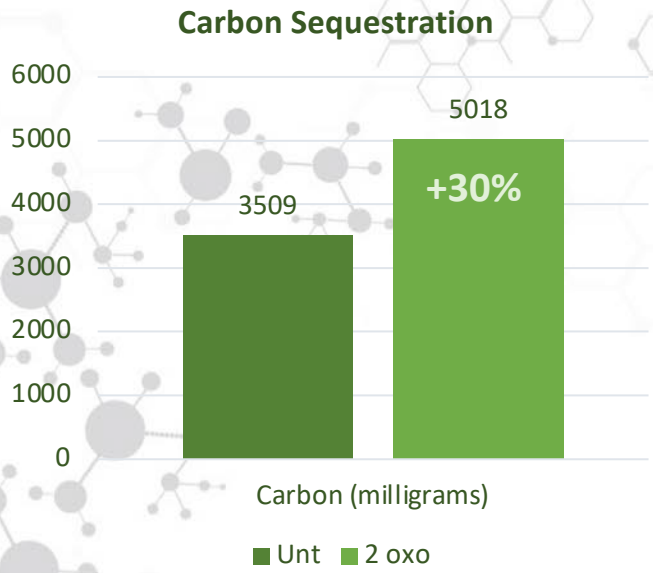
- How does it do it?

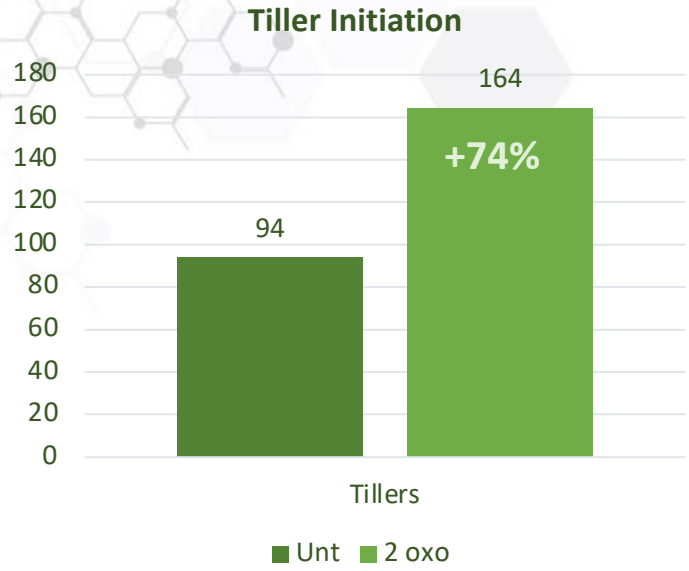


- Features
  - ✓ Increased root biomass
  - ✓ Increased fertiliser uptake
  - ✓ Increased N assimilation
  - ✓ Increased Photosynthesis = increased CO_2 fixation
- Benefits
  - ✓ Increased growth – tillers
  - ✓ Increased leaf protein
  - ✓ Increased nutrient use efficiency
  - ✓ Increased seeds / ear
  - ✓ Increased soil microbial biomass
  - ✓ Enhanced Yield / Quality

Increased Nitrogen Assimilation on Wheat







- **Take Off enhanced nutrient acquisition and assimilation**
- **This was the original brand for the technology of LANL**

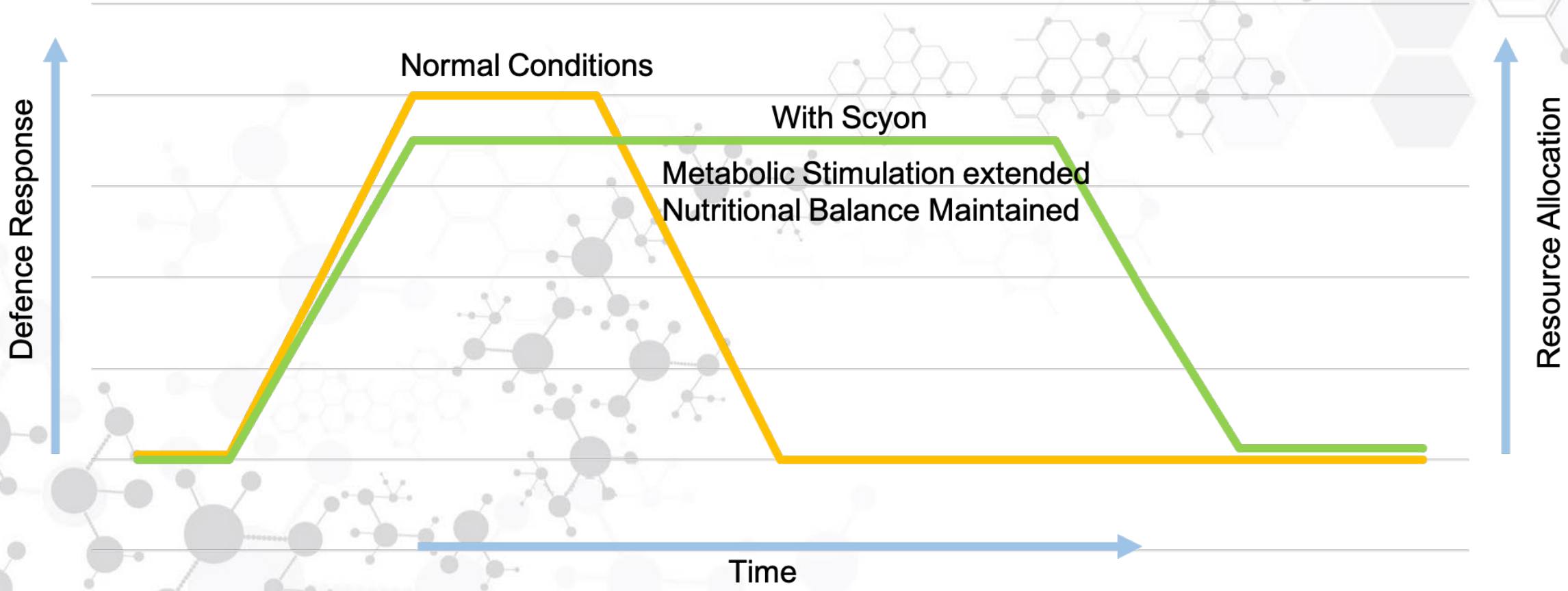
Scyon

- What is it?
  - A unique 50% calcium phosphite formulation in combination with L-PGA to enhance optimise nutrient use efficiency
- What does it do?
  - Its an efficient foliar delivery of phosphorus and calcium fertiliser containing 19%v P_2O_5 and 11% Ca based on the phosphite form of P.
  - It has a lowest salt index of all phosphites making it the safest formulation.
  - Its stabilised formulation ensures the phosphite stays as phosphite and is not oxidise to phosphate.

CROP	TIMING	DOSE ~ L/Ha
Cereals	Foliarly at key growth stages	1.0 - 2.0 L/Ha for most applics
OSR	Foliarly at key growth stages	1.0 - 2.0 L/Ha for most applics
Potatoes	Panting and foliarly at key growth stages	1.0 - 2.0 L/Ha for most applics
Sugar & Fodder Beet	Foliarly at key growth stages	1.0 - 2.0 L/Ha for most applics
Pulses	Foliarly 2nd leaf and onset of flowering	1.0 l/Ha for most applics
Maize	GS 13-16 (add Zinc due to P lock-up)	1.0 l/Ha for most applics
Fruit	Foliarly at key growth stages	2.0 - 3.0 L/Ha for most applics
Vegetables	Planting and foliarly at key growth stages	1.0 - 2.0 L/Ha for most applics
Grass & ForageCrops	GS 12 - 16	1.0 l/Ha for most applics

- How does it do it?
  - The phosphite component "tricks" the plant into a phosphorus deficiency situation, so the plant plant respond by increasing root length, biomass and importantly activity (exudation)
- Features
  - ✓ Increased root biomass, root length, root exudation
  - ✓ Increased N assimilation via L-PGA
  - ✓ Increased Photosynthesis = increased CO_2 fixation
  - ✓ Safest, most tank-mixable, effective phosphite on the market
  - ✓ Peer reviewed as the most effective PO_3 formulation to give confidence
  - ✓ The very small particle size increases solubility and uptake
- Benefits
  - ✓ Increased phosphorus delivery to the plant through increased root exudation
  - ✓ Increased phosphorus use efficiency
  - ✓ Increased soil microbial health and biomass
  - ✓ Lowest chance of crop phyto
  - ✓ Convenient formulation for tank mixing - Unique ability to mix with copper
  - ✓ Enhanced Yield / Quality

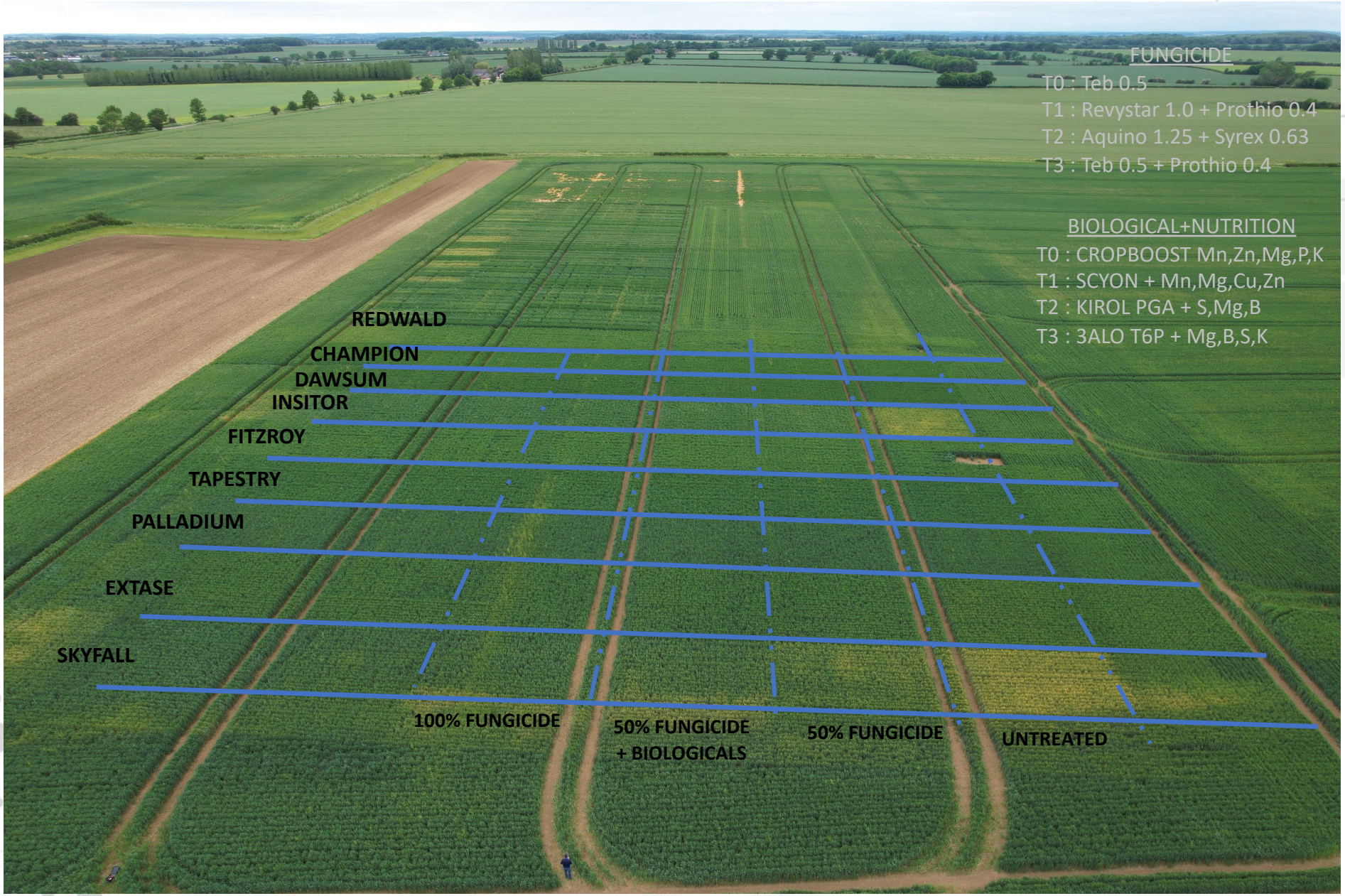
How Scyon Works?



Leaf Health GS 37

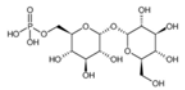
Standard Farm Practice

SFP + Scyon


FUNGICIDE
T0 : Teb 0.5
T1 : Revystar 1.0 + Prothio 0.4
T2 : Aquino 1.25 + Syrex 0.63
T3 : Teb 0.5 + Prothio 0.4
BIOLOGICAL+NUTRITION
T0 : CROPBOOST Mn,Zn,Mg,P,K
T1 : SCYON + Mn,Mg,Cu,Zn
T2 : KIROL PGA + S,Mg,B
T3 : 3ALO T6P + Mg,B,S,K
REDWALD
CHAMPION
DAWSUM
INSITOR
FITZROY
TAPESTRY
PALLADIUM
EXTASE
SKYFALL
100% FUNGICIDE
50% FUNGICIDE + BIOLOGICALS
50% FUNGICIDE
UNTREATED

3Alo T6P

- What is it?

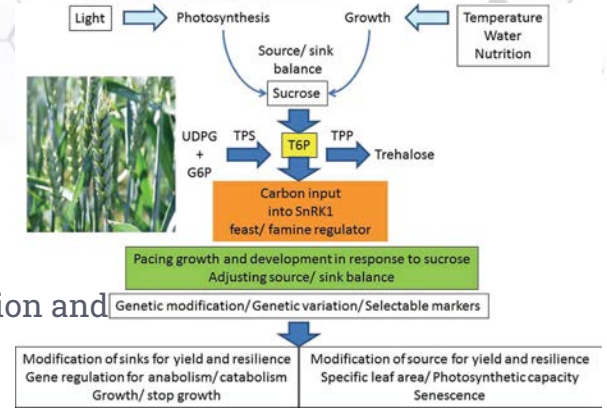


A unique carbohydrate signalling complex comprising T6P designed to enhance carbohydrate management within plants.

- What does it do?
  - The unique combination work synergistically to enhance the storage and transportation of sugars within the plant
  - It is one of the the critical mechanisms linking carbon assimilation and the growth of plants
  - It mitigates plant stress caused by adverse environmental factors.
  - In the growing parts of the plant the level of T6P signals how much sucrose is available for growth and accumulation of storage reserves.
  - It also impacts on development transitions within plant physiology e.g. flowering leads to seed formation by linking development to sugar supply T6P supports plants to maximise yield without running our of carbon before seed production is finished.

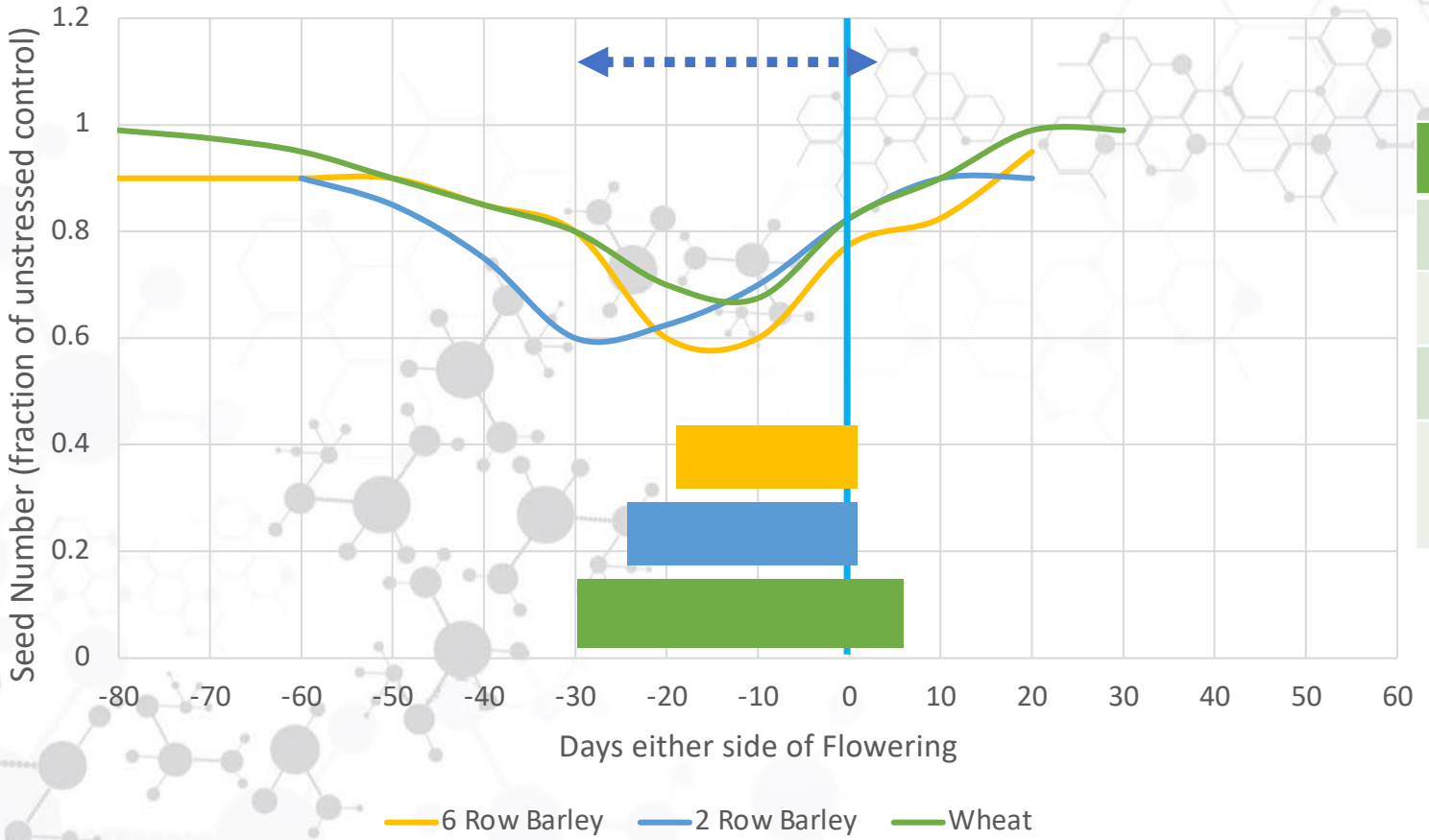
CROP	TIMING	DOSE ~ L/Ha
Cereals	GS 39 - 65 (trials optimum GS59)	1.0
OSR	GB – Mid Flowering (trials optimum	1.0
Potatoes	Onset & Mid Bulking	1.0 x 2
Maize	6 leaf stage	1.0
Pulses	Onset of flowering	1.0

- How does it do it?
  - Through a process known as “neofunctionalism” excess sucrose produced in photosynthesis is diverted to newly fixed carbon and amino acids.
- Features.
  - ✓ Enhanced root development
  - ✓ Increased shoot biomass
  - ✓ Critical for optimal crop physiology
  - ✓ Enhanced carbohydrate management
  - ✓ Increase chlorophyll production and prolonged photosynthesis



- Benefits
  - ✓ Improved photosynthetic capacity providing higher levels of sugar for growth and development
  - ✓ Improved tolerance to stress esp’ drought by partitioning sugars more efficiently to maintain crop growth / yields
  - ✓ Enhanced Yield / Quality
  - ✓ Enhanced seed quality
  - ✓ Increased crop profitability

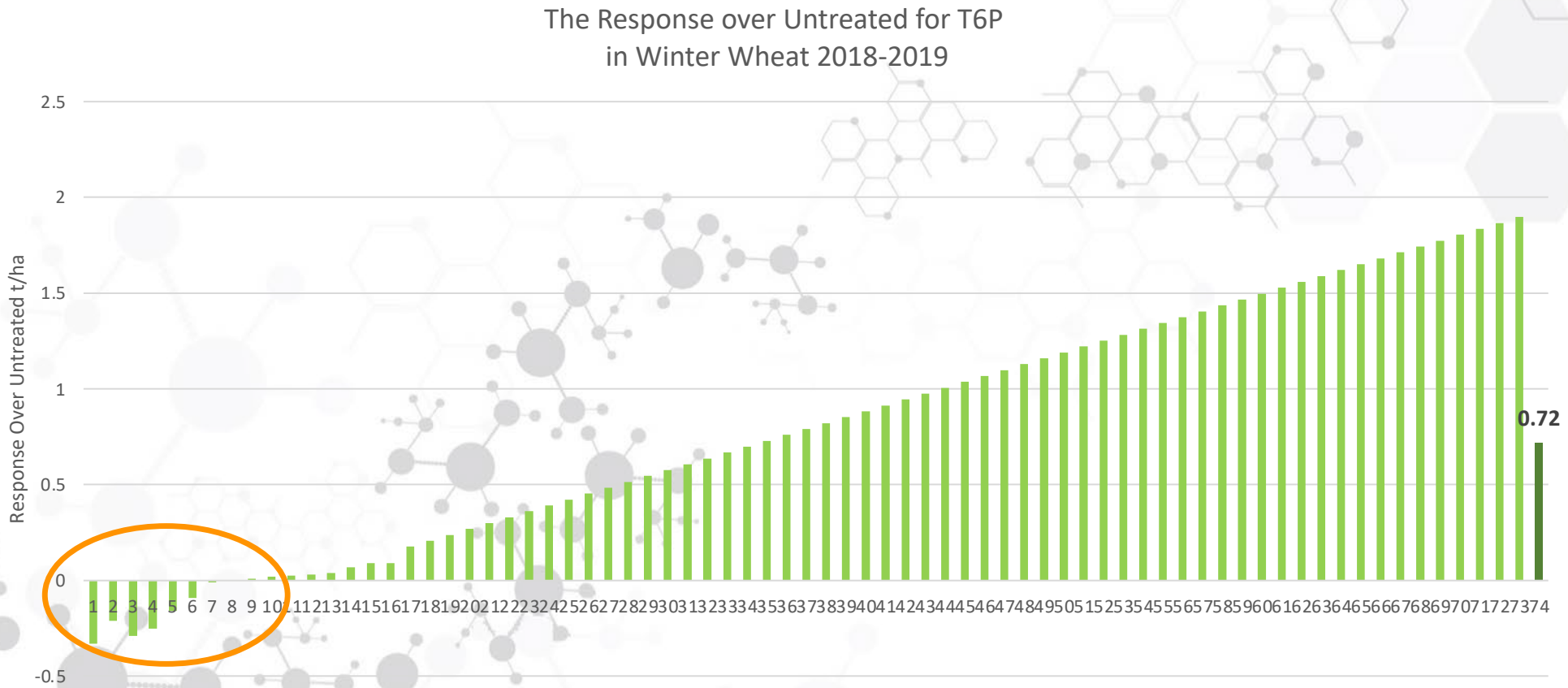
Stress relative to Flowering



Time	Response
Unt	6.1
T6P T2	6.6
T6P T3	6.5
T6P T2&T3	6.7

Key timing was T2

T6P



The neutral or negative responses were all on manganese deficient crops, repeated in potatoes – so 2020 recs will include a note on Mn and boron sufficiency as this process is heavily dependent upon Mn/Boron availability

Element	Untreated	3Alo T6P Treated	% Increase
N	2.19	2.35	+7%
P	0.3	0.39	+30%
K	0.51	0.53	+4%
S	0.14	0.15	+7%
Mg	0.11	0.14	+27%
Ca	0.04	0.05	+25%
Fe	37	48	+30%
Mn	37	44	+19%
Zn	19	24	+26%
Cu	3.2	4.2	+31%
B	1.0	1.1	+10%
Mo	0.7	1	+43%

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