Crop Nutrition Planning
Oilseed & Cereals

Mark Tucker

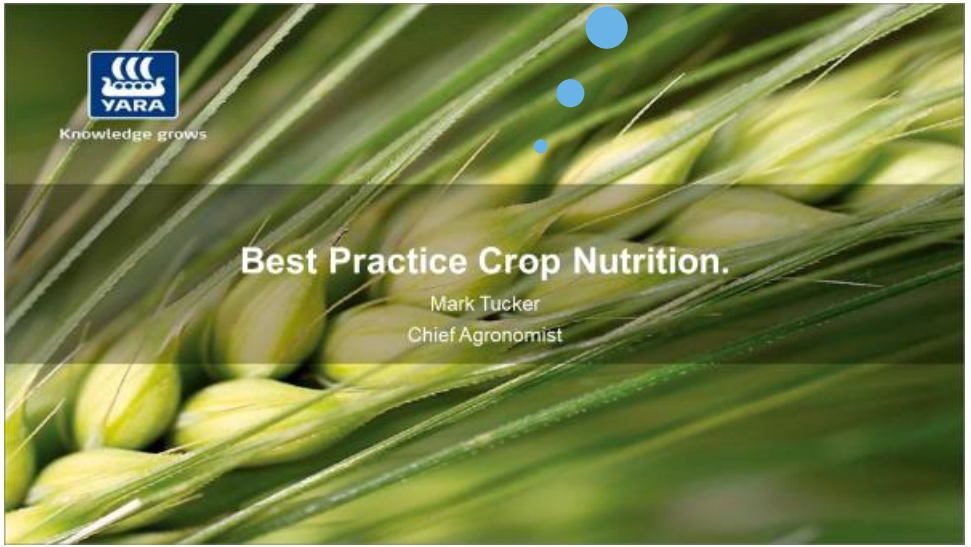
Yara UK & Ireland

Euroopa Maaelu Arengu Põllumajandusfond: Euroopa investeeringud maapiirkondadesse

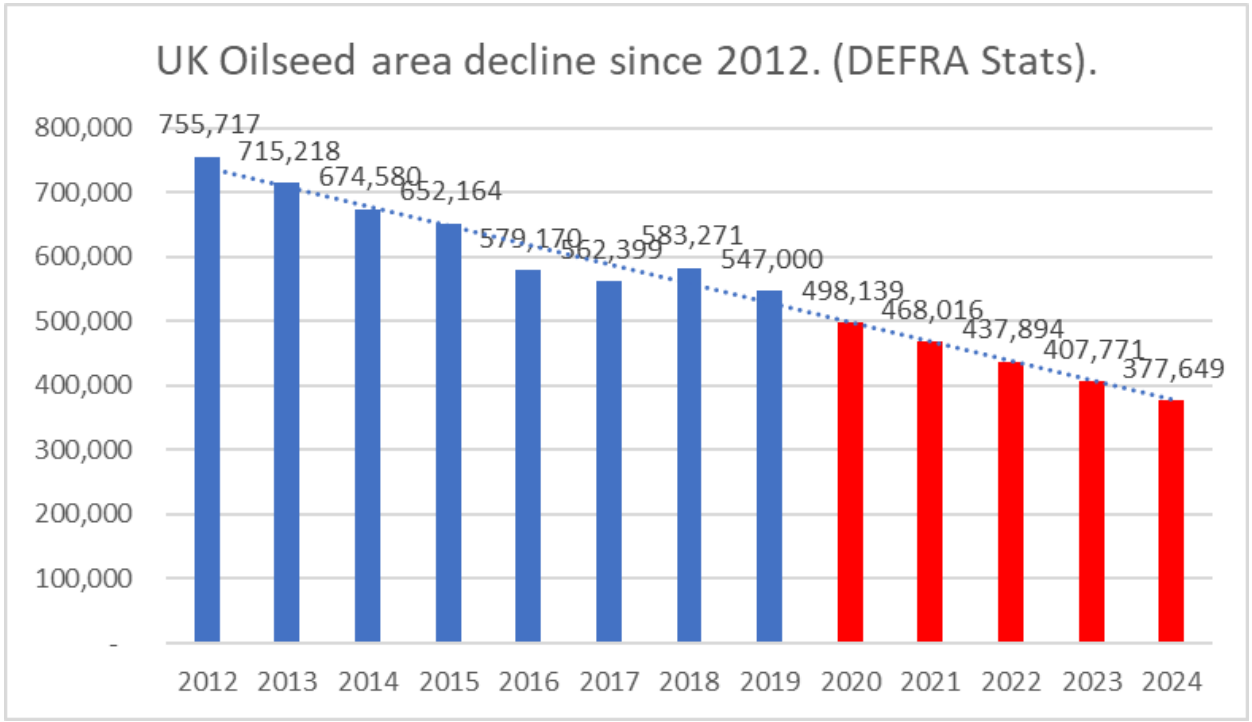
Scope of discussion

- Some crop trends in the UK
- Recent findings from data
- Future considerations

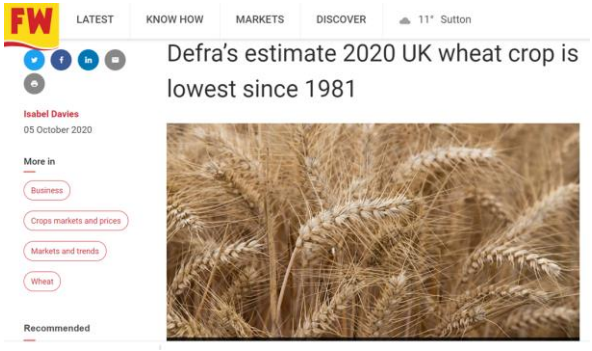
Back in 2014 I shared thoughts



Back in 2014 the Oilseed area was 675,000 ha, in season 2020/2021 it is expected to be approx. 275,000 ha.



Season 2019/2020 has been very unusual:



- The wettest Autumn in 2019
- And a very dry spring in 2020

- Resulting in a 10.1 m tonne harvest compared to the typical 15.1 mtonnes

The key findings of the AHDB survey were:

- GB wheat area is estimated at 1,363Kha, a 25% decrease from 2019.
- GB spring barley area is estimated at 1,063Kha, up 52% from 2019.
- GB winter barley area is estimated at 296Kha, a 34% decrease from 2019.
- Area of oilseed rape in England & Scotland is estimated at 387Kha, down 26% from 2019.
- Area of oats in England & Scotland is estimated at 211Kha, a 21% increase from 2019.

Season 2020/2021 is already very different again…

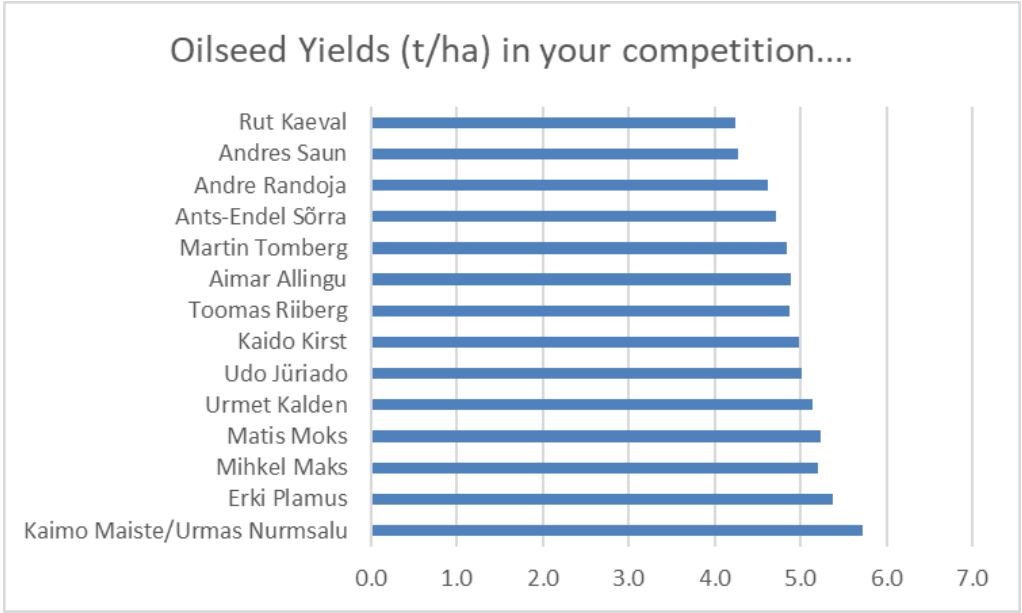
- Oilseed establishment has been excellent, where did all the Cabbage Stem Flea Beetle go??
- Rainfall has been more normal so plantings of wheat are high – anticipate a 1.9 mHa crop of winter wheat.
- Autumn temperatures are higher than average so crops are advanced .

Since 2014, the Yield Enhancement Network has continued its expansion into more crops:

- Wheat
- Oilseed
- Pulses
- Grass

Considering the Oilseed crop….

Great to see your own high yields



The UK 2019 Oilseed YEN Gold winner….

- Best % of potential yield (East Midlands): **85%** of 8.4t

- Location: Kent
- Variety: Campus
- Yield: 7.19t/ha

Conclusions from 2019…

- Sink size (**seed number**) critical for yield
  - Biomass less important
  - Target optimum canopy size at flowering
- High yielders tended to have greater **soil & seed Mg**
- High yielding crops had **10 extra days** from flowering to desiccation
- Winners often use **low seed rate** (30-45 seeds/m^2)

The biggest current challenge has been establishing the crop:

- Cabbage stem flea beetle (Psylliodes chrysocephala)
- Consumes the leaves as the crop grows
- Then the larva eat through the stem leading to early crop senescence

To aid with establishment we have started to look at nutrient based seed treatments:

YaraVita GLYTREL MnP

YaraVita GLYTREL MnP is a liquid micronutrient fertiliser containing a manganese and phosphate for foliar application to a wide range of crops and for use as a seed treatment on cereals and maize.

Unique Seed Treatment

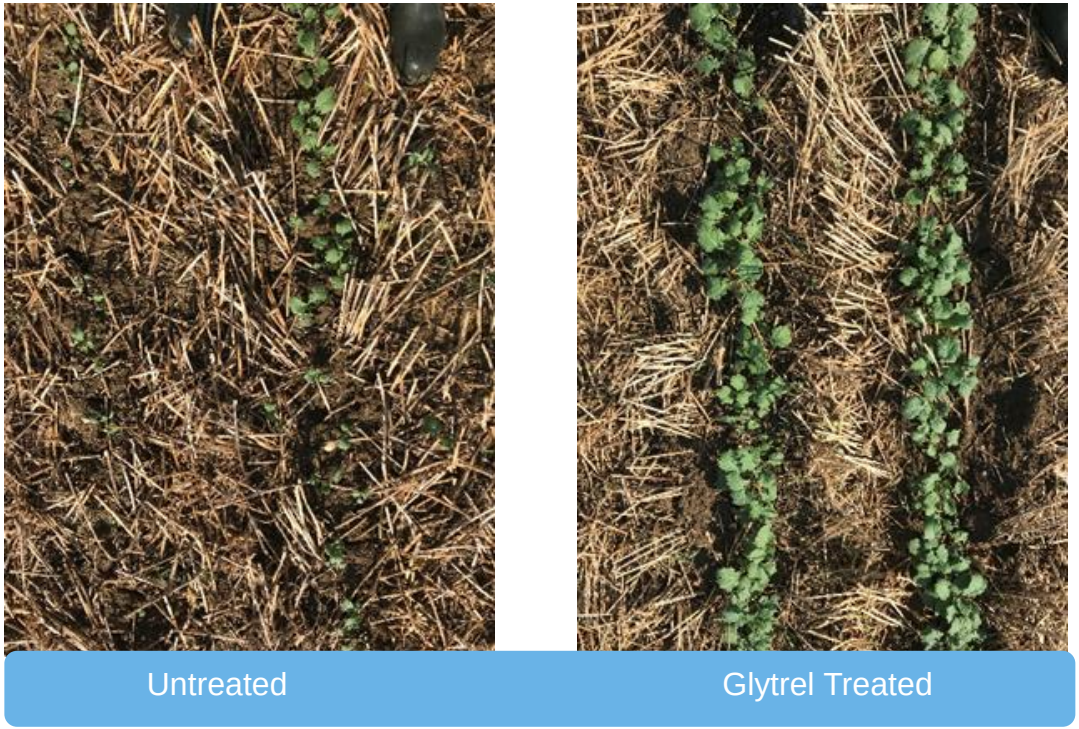
Highly concentrated liquid formulation
Can be co-applied with other seed treatments
Evenly distributed over the whole batch
Good flowability through the drill
No adverse effects on germination

Nutrient Composition

Form: Liquid

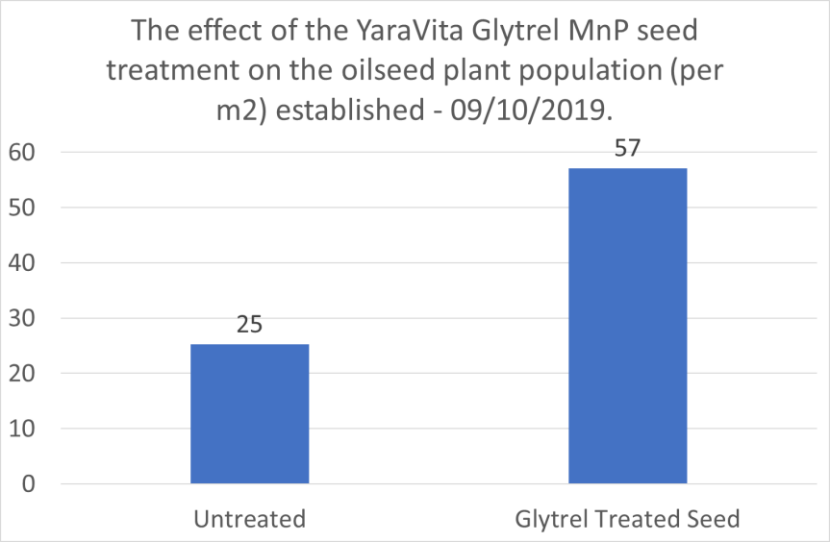
P_2O_5	93 g/l	Mn	93 g/l

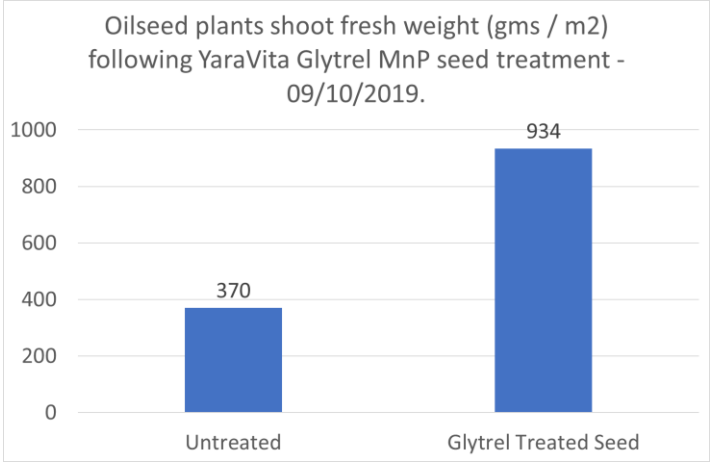
Early establishment was faster and more even….



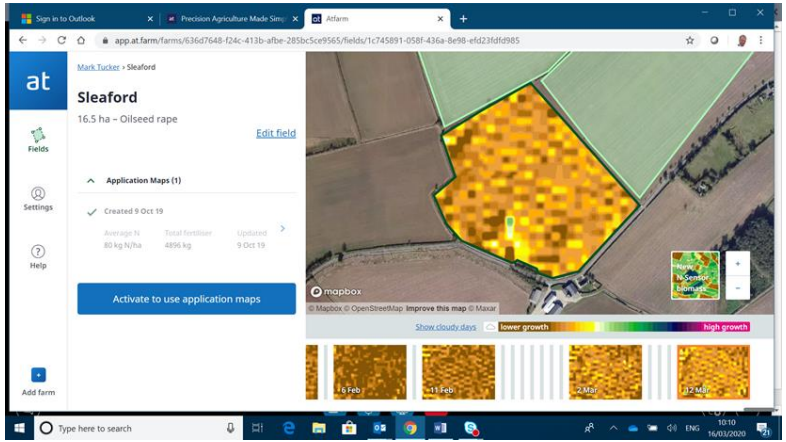
Untreated | Glytrel Treated

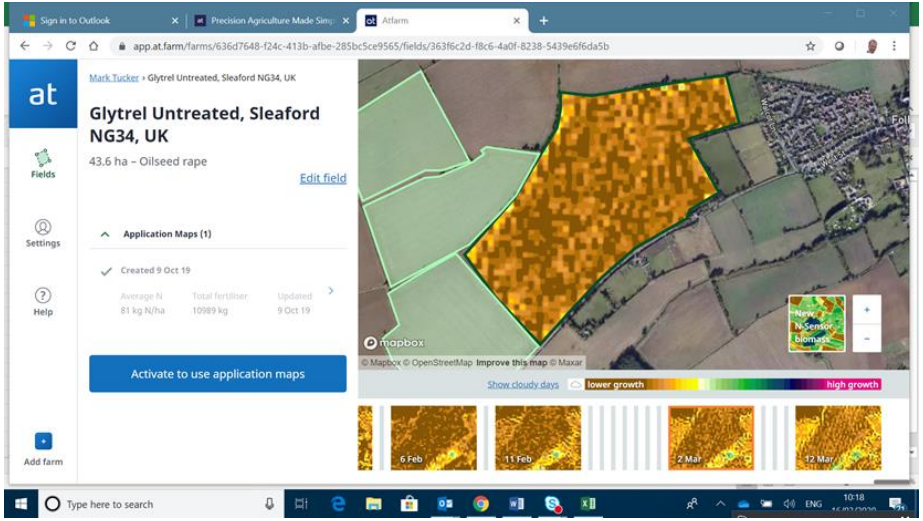
2019 establishment results…



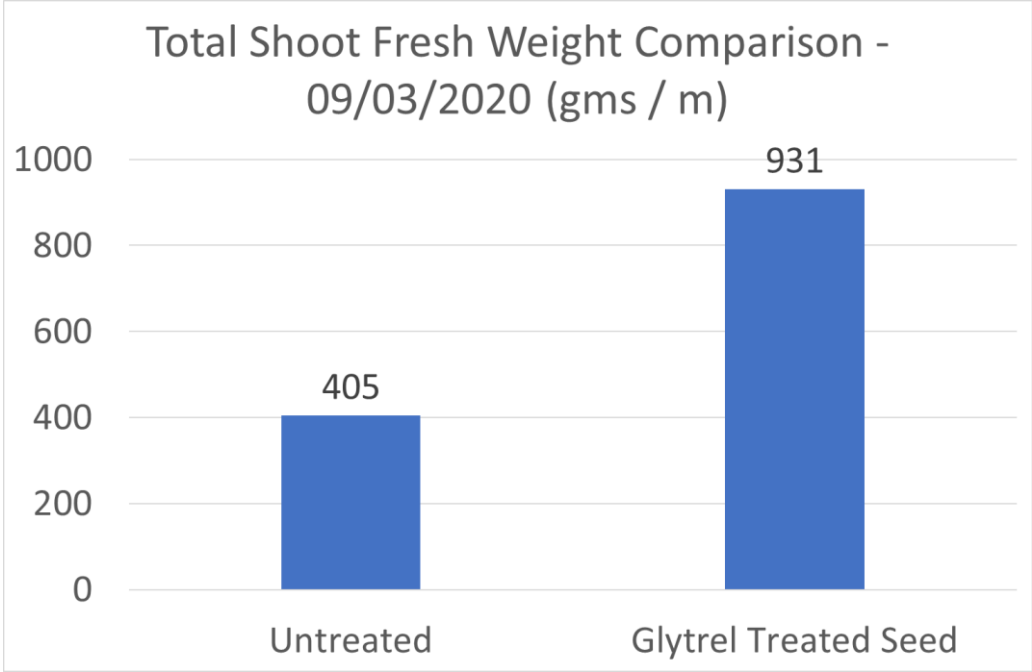


Yara atfarm service highlighted the improvement with the brown, low biomass crop where NO seed treatment applied…





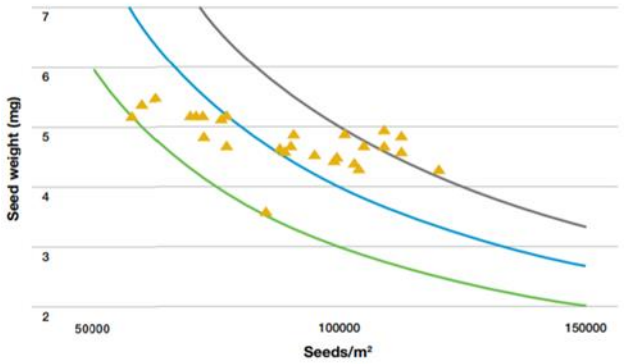
This continued going into the spring….



‘Sink’ size is critical = seed number X seed weight

- YEN has again identified that the seed number is really critical for high yield.
  - Too many pods, reduces the seed number, negatively affecting yield.

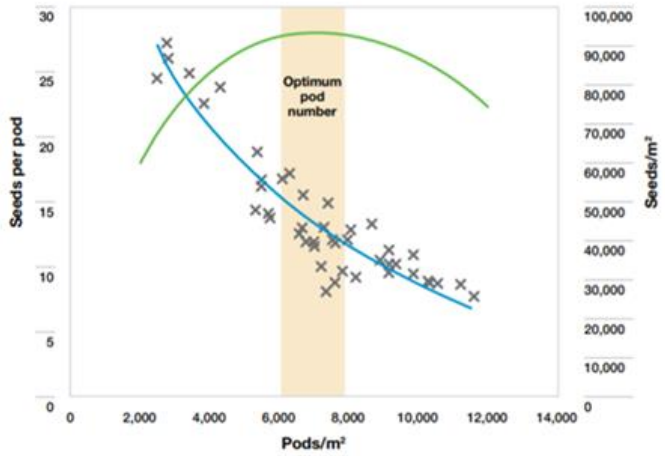
- Key therefore is to consider what helps deliver a large number of seeds.
  - Good Seed numbers will come from good pollination and seed set during the two – three weeks after mid flowering.
  - Photosynthesis during this time determines seed set



Graph 2. The two components of yield

Observations of seed number (seeds/m²) and seed weight (mg) from commercial crops and combinations required for target yields.

- 3 t/ha
- 4 t/ha
- 5 t/ha
- Commercial crops



What drives photosynthesis and seed set…

- **Magnesium and Nitrogen**
  - Central to the chlorophyll molecule – crop greenness
- **Molybdenum**
  - Not as widely deficient but plays a key role in how the plant metabolises nitrogen. Deficiency can be triggered by excessive sulphur use.
- **Manganese**
  - This absorption of light energy helps **split water molecules** into hydrogen and oxygen, generating free electrons. ... Manganese is essential in this water splitting and is called the element of life for this reason.
- **Boron**
  - Assists with plant development, including seed, cell-wall and protein formation, sugar translocation, **germination of pollen grains and growth of pollen tubes**. Deficiencies can lead to incomplete pollination

Foliar applied nutrients continues to be linked with high yielding crops, especially Magnesium and Boron..

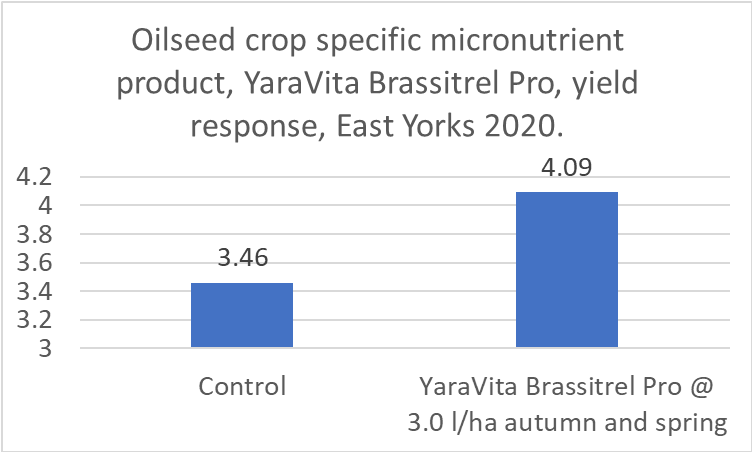
- Yara research has identified those key nutrients in Oilseed as:
  - Magnesium
  - Boron
  - Molybdenum
  - Manganese
  - Calcium

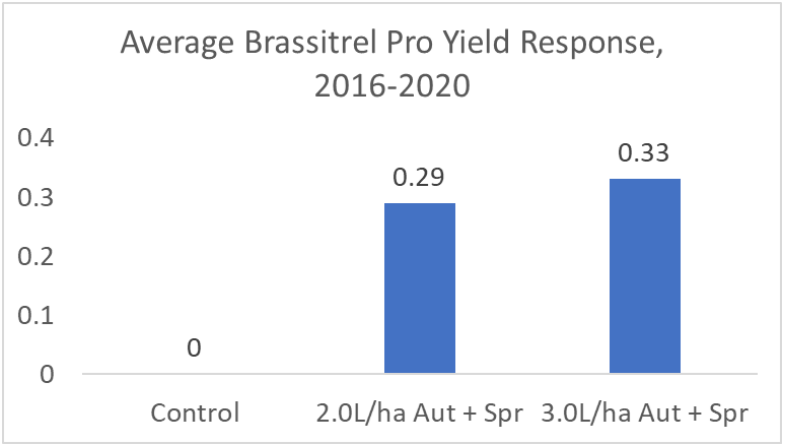
- Which led to the product development – YaraVita Brassitrel Pro.

- Many UK farms have deficiencies in these key nutrients – especially, Boron, Magnesium and Manganese.

Long term trials have shown the yield benefit associated with using ‘Crop Specific’ formulations….

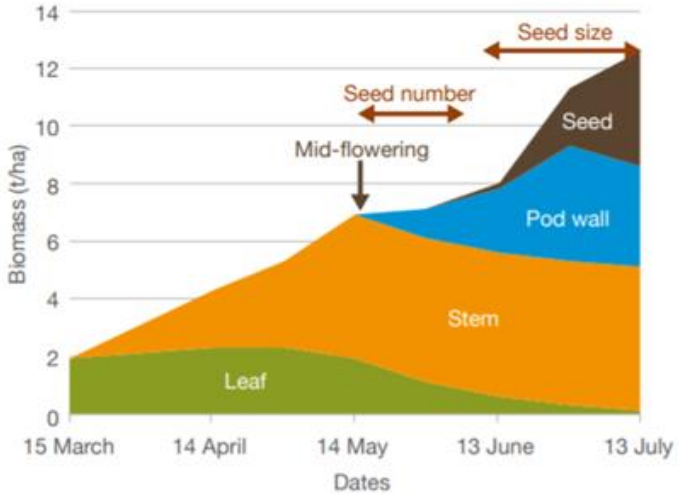
- A 5 year average yield response of 0.33 t/ha
  - This is a Return on Investment of 6:1.
- Data is also indicating improved oil%
- 2020 trials gave a 0.63 t/ha yield increase.





High yielding crops had an extra 10 days from flowering to desiccation.

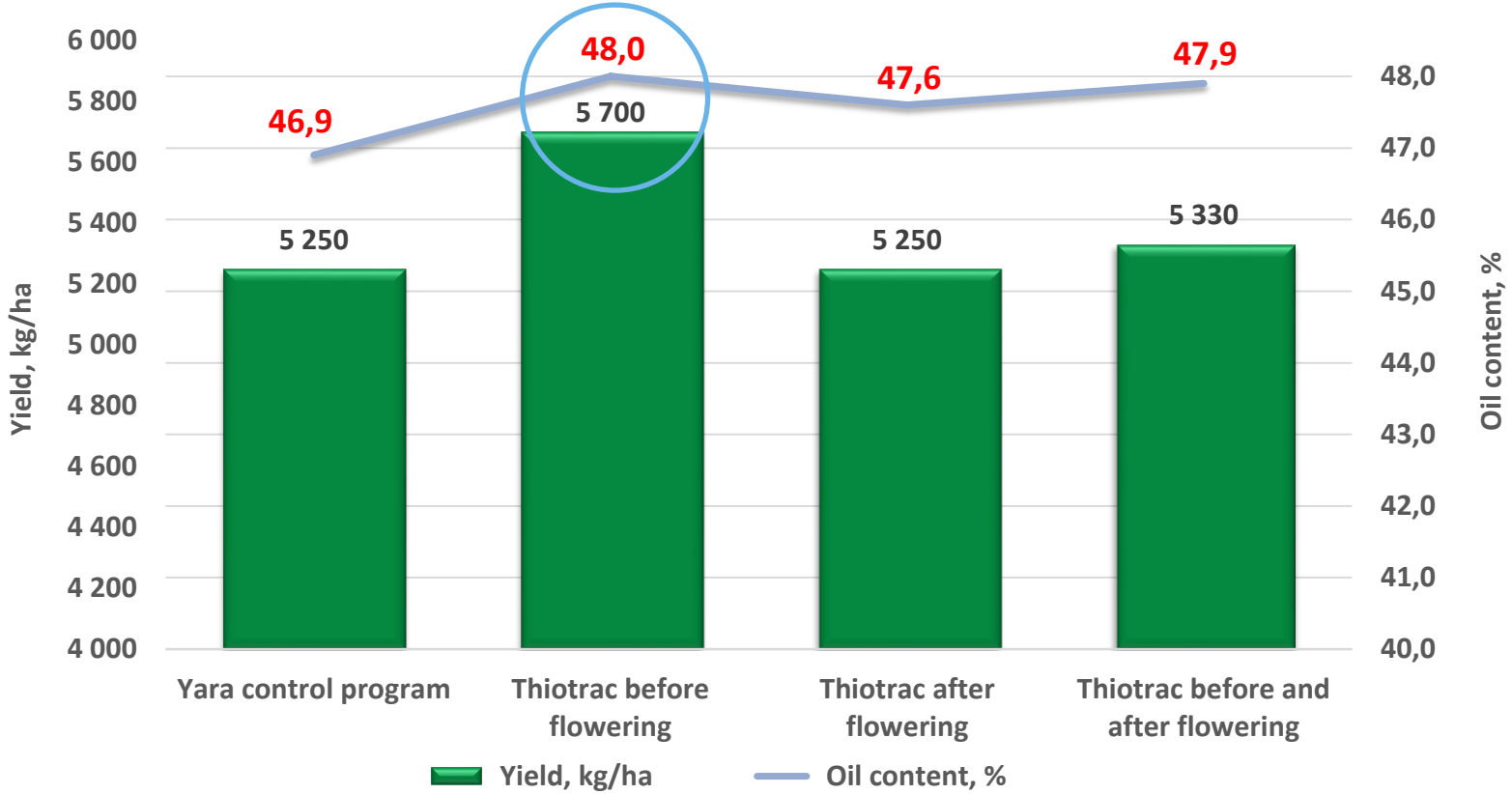
- In a two week period from mid June the biomass yield increases dramatically as seed size increases during seed fill.
- At this time the crop is relying on the last few youngest leaves and green pods to photosynthesise.
- It is really important to maintain Green Area Duration.



WOSR YaraVita Thiotrac trial 2020, Kuusiku trial centre.

Application	Yara programm - control	Thiotrac before flowering	Thiotrac after flowering	Before and after flowering	Date
Base NPK fertilization	YaraMila NPK 9-12-25 300 kg/ha	YaraMila NPK 9-12-25 300 kg/ha	YaraMila NPK 9-12-25 300 kg/ha	YaraMila NPK 9-12-25 300 kg/ha	09.08.2019
Autumn NS application	YaraBela AXAN NS 27-4 110 kg/ha	YaraBela AXAN NS 27-4 110 kg/ha	YaraBela AXAN NS 27-4 110 kg/ha	YaraBela AXAN NS 27-4 110 kg/ha	24.09.2019
Autumn foliar fertilizer 1	YaraVita KOMBIPHOS 2,0 l/ha	YaraVita KOMBIPHOS 2,0 l/ha	YaraVita KOMBIPHOS 2,0 l/ha	YaraVita KOMBIPHOS 2,0 l/ha	18.09.2019
Autumn foliar fertilizer 2	YaraVita BRASSITREL PRO 1,5 l/ha	YaraVita BRASSITREL PRO 1,5 l/ha	YaraVita BRASSITREL PRO 1,5 l/ha	YaraVita BRASSITREL PRO 1,5 l/ha	18.09.2019
Autumn foliar fertilizer 3	YaraVita BORTRAC 1,5 l/ha	YaraVita BORTRAC 1,5 l/ha	YaraVita BORTRAC 1,5 l/ha	YaraVita BORTRAC 1,5 l/ha	18.09.2019
Spring NPK/ fertilizer	YaraMila NPK 20-5-15 200 kg/ha	YaraMila NPK 20-5-15 200 kg/ha	YaraMila NPK 20-5-15 200 kg/ha	YaraMila NPK 20-5-15 200 kg/ha	27.03.2020
1'st NS top dressing	YaraBela SULFAN 24-6 250 kg/ha	YaraBela SULFAN 24-6 250 kg/ha	YaraBela SULFAN 24-6 250 kg/ha	YaraBela SULFAN 24-6 250 kg/ha	27.03.2020
2'nd NS top dressing	YaraBela SULFAN 24-6 250 kg/ha	YaraBela SULFAN 24-6 250 kg/ha	YaraBela SULFAN 24-6 250 kg/ha	YaraBela SULFAN 24-6 250 kg/ha	21.04.2020
Leaf fertilizer early spring	YaraVita KOMBIPHOS 3,0 l/ha	YaraVita KOMBIPHOS 3,0 l/ha	YaraVita KOMBIPHOS 3,0 l/ha	YaraVita KOMBIPHOS 3,0 l/ha	07.04.2020
Leaf fertilizer early spring	YaraVita BORTRAC 2,0 l/ha	YaraVita BORTRAC 2,0 l/ha	YaraVita BORTRAC 2,0 l/ha	YaraVita BORTRAC 2,0 l/ha	07.04.2020
Leaf fertilizer BBCH 33-39	YaraVita BRASSITREL PRO 2,0 l/ha	YaraVita BRASSITREL PRO 2,0 l/ha	YaraVita BRASSITREL PRO 2,0 l/ha	YaraVita BRASSITREL PRO 2,0 l/ha	08.05.2020
Leaf fertilizer BBCH 33-39	YaraVita BORTRAC 1,0 l/ha	YaraVita BORTRAC 1,0 l/ha	YaraVita BORTRAC 1,0 l/ha	YaraVita BORTRAC 1,0 l/ha	08.05.2020
THIOTRAC before flowering	-	**YaraVita THIOTRAC 5,0 l/ha**	-	**YaraVita THIOTRAC 5,0 l/ha**	14.05.2020
THIOTRAC after flowering	-	-	**YaraVita THIOTRAC 5,0 l/ha**	**YaraVita THIOTRAC 5,0 l/ha**	11.06.2020
NPKS autumn	**57 N - 16 P - 62 K - 12 S**	**57 N - 16 P - 62 K - 12 S**	**57 N - 16 P - 62 K - 12 S**	**57 N - 16 P - 62 K - 12 S**	
NPKS spring	**160 N - 5 P - 25 K - 36 S**	**160 N - 5 P - 25 K - 36 S**	**160 N - 5 P - 25 K - 36 S**	**160 N - 5 P - 25 K - 36 S**	
NPKS TOGETHER	**217 N - 21 P - 87 K - 48 S**	**217 N - 21 P - 87 K - 48 S**	**217 N - 21 P - 87 K - 48 S**	**217 N - 21 P - 87 K - 48 S**	
N:S ratio in spring	4,4:1	4,4:1	4,4:1	4,4:1	
N+S before flowering	.	1,0 + 1,5 kg/ha	-	1,0 + 1,5 kg/ha	
N+S after flowering	-	-	1,0 + 1,5 kg/ha	1,0 + 1,5 kg/ha	

WOSR THIOTRAC TRIAL 2020, KUUSIKU – YIELDS

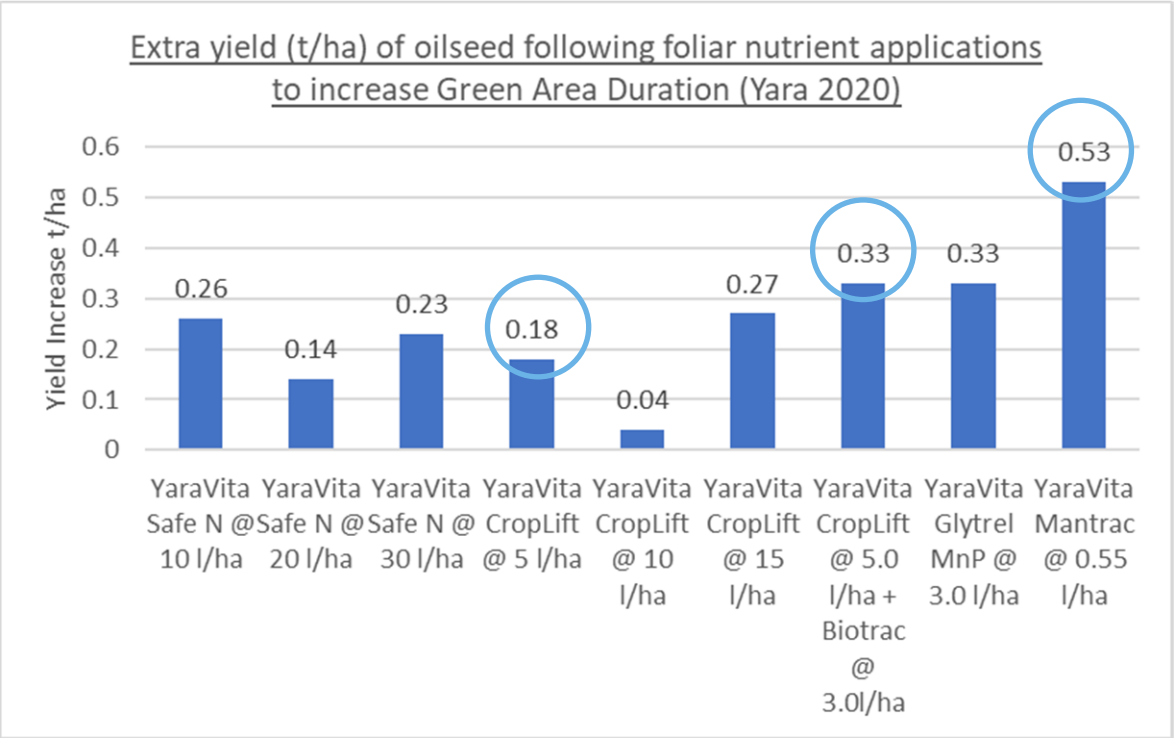


WOSR THIOTRAC TRIAL 2020, KUUSIKU - PROFITABILITY

	Without Thiotrac	Thiotrac before flowering	Thiotrac after flowering	Thiotrac before and after flowering
Yield	**5 250 kg/ha**	**5 700kg/ha**	**5 250kg/ha**	**5 330 kg/ha**
EXTRA YIELD	**-**	**+450 kg/ha**	**-**	**+80 kg/ha**
Oil content %	46,9%	48,0%	47,6%	47,9%
Oilseed rape price home	363 €/tn	363 €/tn	363 €/tn	363 €/tn
Extra for oil (base 40%)	37,6 €/tn	43,6 €/tn	41,4 €/tn	43,0 €/tn
TOTAL OSR sales price	**400,6 €/tn**	**406,6 €/tn**	**404,4 €/tn**	**406,0 €/tn**
Sales value of the crop	1 943 €/ha	2 112 €/ha	1 947 €/ha	1 978 €/ha
Fertilizer program costs	-359 €/ha	-376 €/ha	-376 €/ha	-392 €/ha
Sales value - fertil. costs	1 584 €/ha	1 738 €/ha	1 571 €/ha	1 586 €/ha
PROFITABILITY	**-**	**+154 €/ha**	**-13 €/ha**	**+2 €/ha**

In 2020 Yara UK continued the research to improve green area duration.

- Over the last 8 years we consistently get an extra 0.25 – 0.3 t/ha yield from foliar nutrient applications at the end of flowering.
- In 2020 this again was the case. A number of options were tested with YaraVita Mantrac Pro giving the best result.
- YaraVita Biotrac was also tested and improved the YaraVita Croplift performance



In summary for oilseed

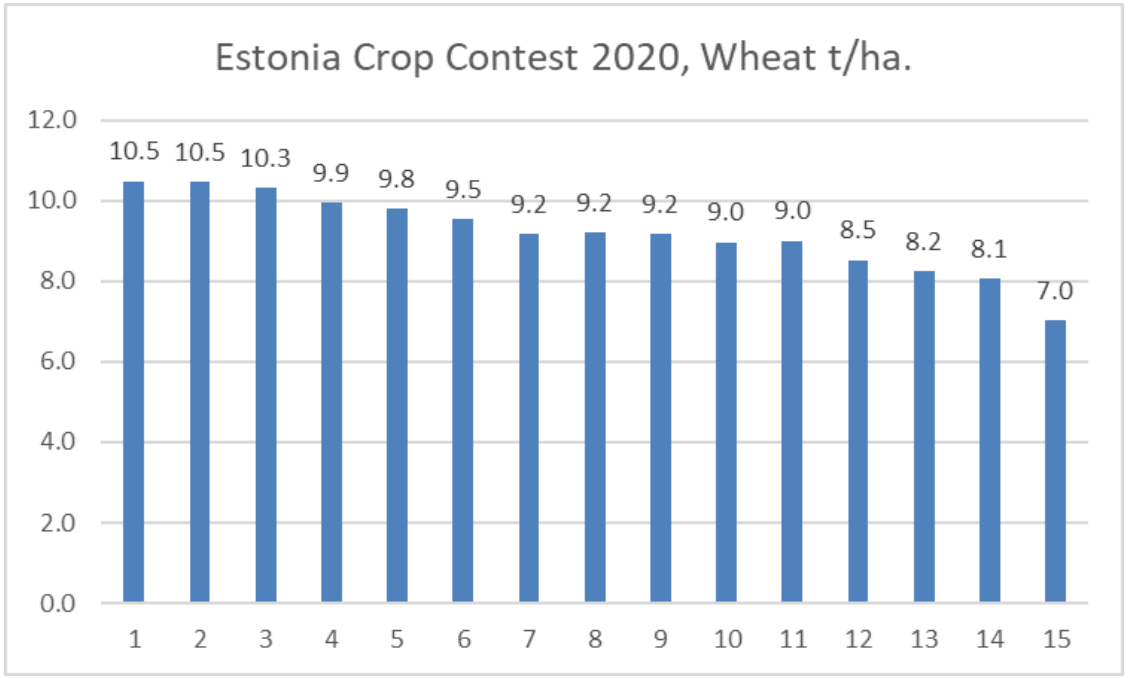
- Establishment of the crop is the #1 challenge, but this can be helped by using nutrient seed treatments such as YaraVita Glytrel MnP.
- Foliar nutrition is very important with magnesium being of particular importance. Crop Specific products such as YaraVita Brassitrel Pro consistently deliver an extra 0.3 t/ha.
- The period from mid flowering is critical for high yield so ensure you maintain a green leaf and pod canopy as seed fill begins.
- Late foliar nutrition applications again consistently deliver an extra 0.3 t/ha.

Considering the Wheat crop…

Mark Stubbs goes for gold in YEN Cereal Award 2019

Location: Lincolnshire
Variety: Siskin
Yield: 16.3t/ha
Best % of potential yield (East Midlands): **85%** of 19.2t

…you are having some great results…..



Wheat – Rannu Seeme, Estonia
Average annual wheat yields produced on the farm are 7 tonnes per hectare (with 8 tonnes per hectare achieved in 2012). This is 50% higher than the average Estonian wheat yield of 4.63 tonnes/hectare

So what have some of the key learnings been from the YEN Cereals project…

- The Farmer ‘X Factor’ = Attention to detail and making well informed decisions, using farm data. Being ‘appropriate’ and treating each season differently by reacting to conditions.

- ‘HIGH BIOMASS’ is the #1 target, something I highlighted back in 2014. The Harvest Index tells us this as 50% of biomass converts into yield, therefore the higher the biomass the higher the yield.

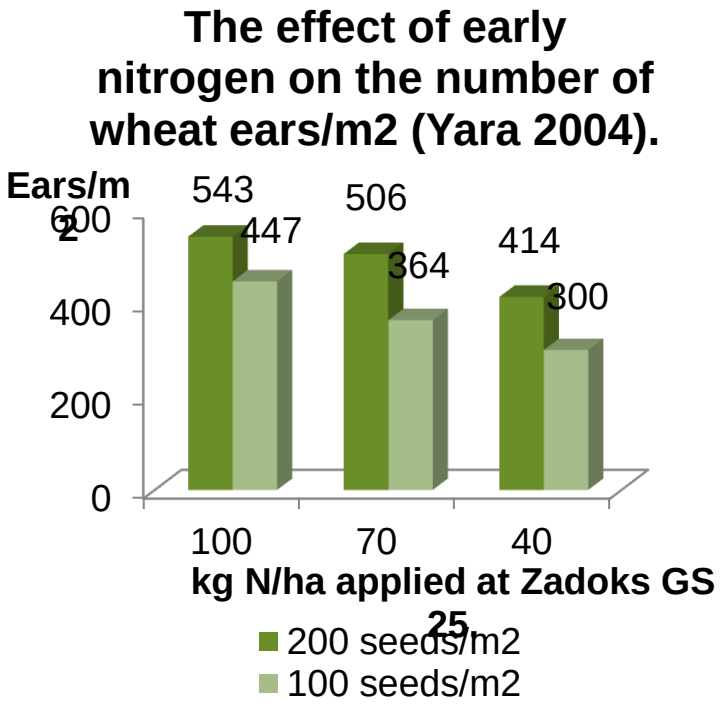
- Spring applied phosphate is showing an association with high yields. Phosphate deficiency is being highlighted as more of an issue than previously considered.

- Liquid UAN is also showing some association with limiting yield potential.

So how do we drive for High Biomass.

- In the UK crops are being drilled later to enable good Blackgrass control with Glyphosate.
- Later drilled (October / November) wheat has less biomass going into the winter, therefore nitrogen management in early spring is critical.
- High yields are being achieved where farmers are applying high rates (70 – 100 kg N/ha with their first Nitrogen applications in the spring at GS 25.
- This is even more relevant with March/April being the driest months of the year in the UK. Early Nitrogen also builds a bigger root biomass – more tillers = more roots.

The Foundation Phase – early spring nitrogen influences tillering capacity and final ear number.



Nitrogen source is important - Improved root growth with Nitrate

- There is clear evidence from nutrient solution trials (left) and from fertigation trials that better root growth occurs with nitrate at N concentrations common in arable soils.

Maize

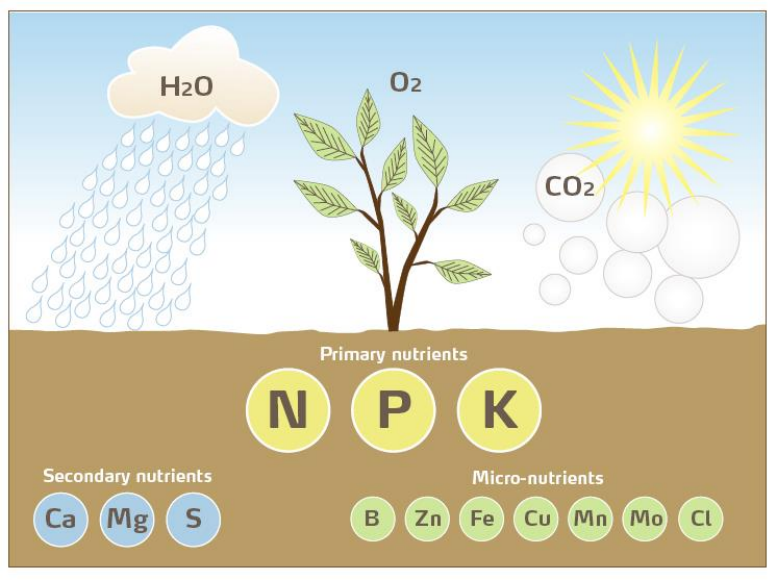
NO3-N NH4-N

Source: RC Hanninghof, 2004

Source: Gerendás et al., 1997

…this biomass contains 13 mineral nutrients, which must be supplied from somewhere….

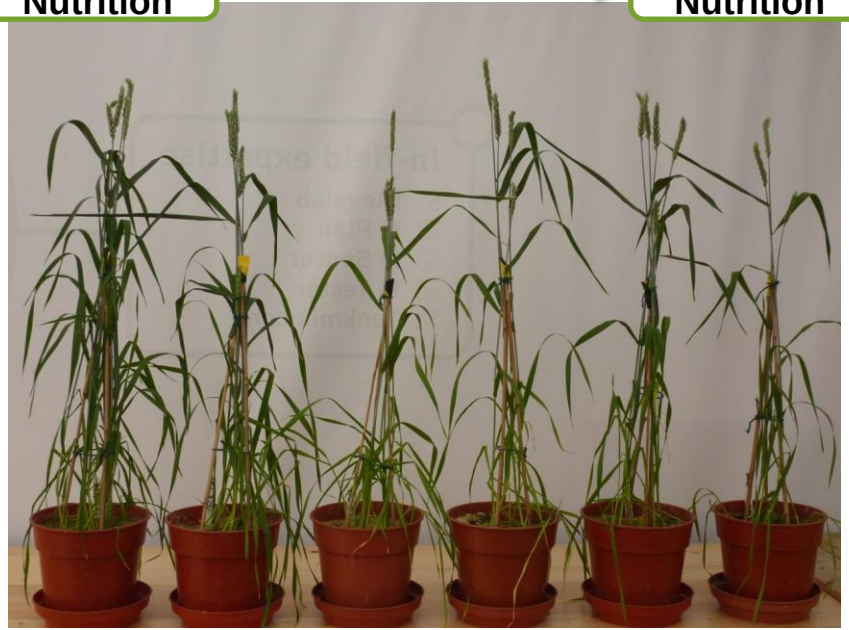
Crops absorb mineral nutrients and water from the soil



Mineral nutrients are the essential building blocks for crops

Visible symptoms are rarely evident in the field..

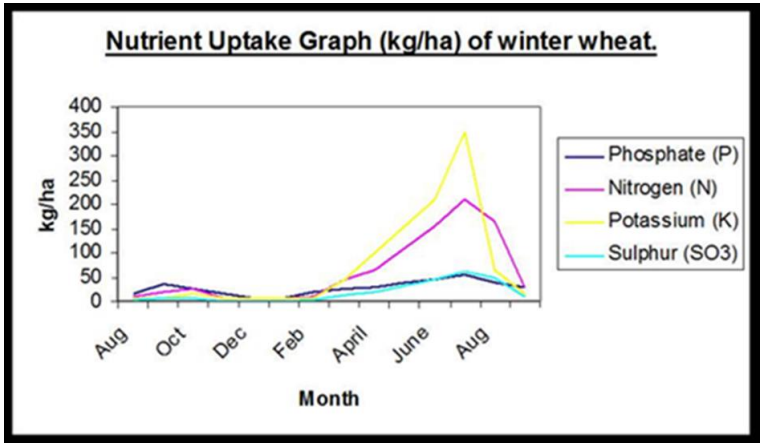
Complete Nutrition → **Incomplete Nutrition**



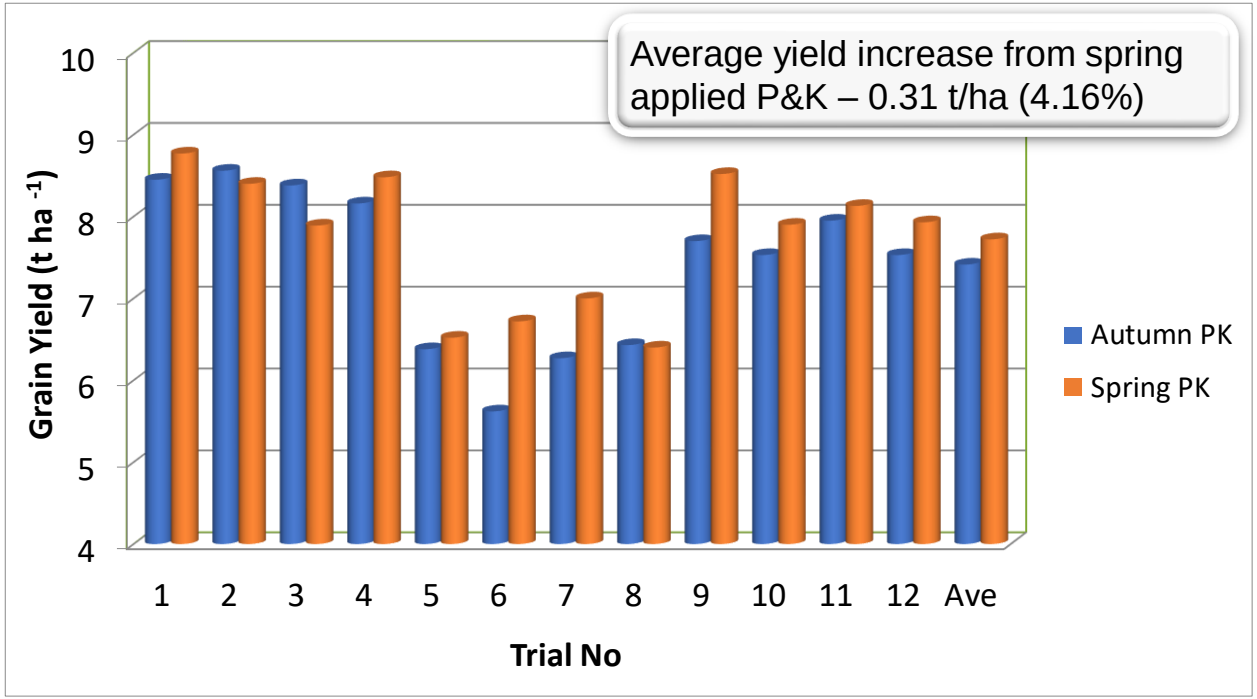
- Seen in isolation no immediately visible symptoms.
- Put alongside a healthy plant and the difference becomes clear.
- Note the lack of biomass as N,P,K,S and micros are removed from the nutrient solution = yield penalty.

Spring applied phosphate…

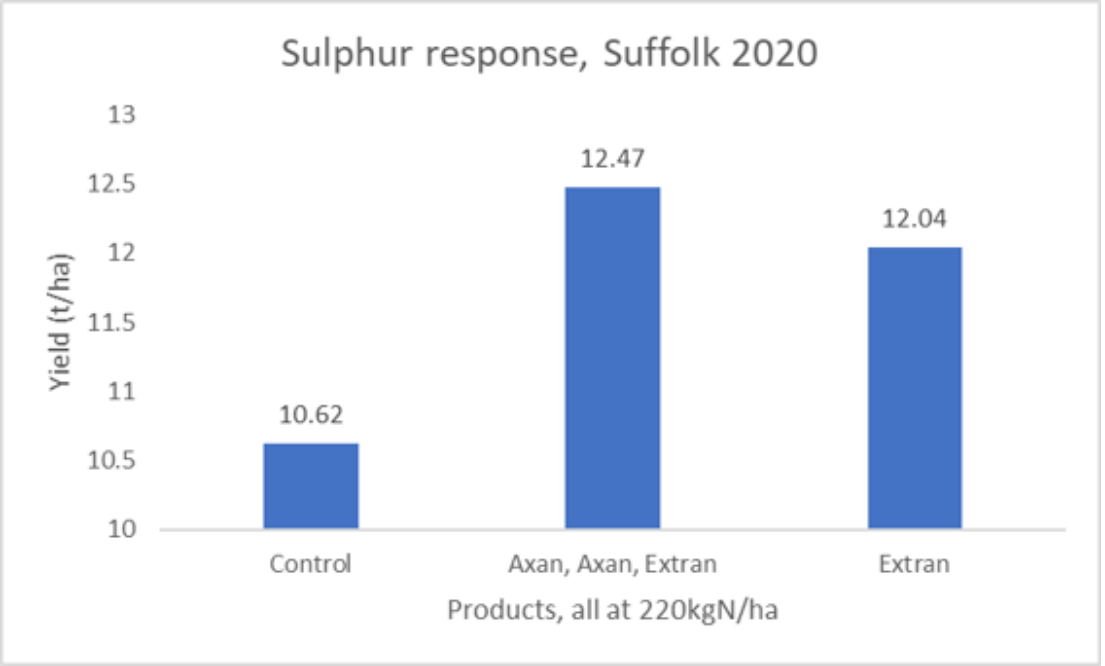
- YEN Grain analysis benchmarking has revealed many crops in the UK are low in phosphate.
- Spring applied phosphate is showing a good association with high yields.
- This Spring Starter Concept has been advocated by Yara for many years through recommendations to use a YaraMila NPKS as the first spring dressing.
- The YaraMila products have the different types of phosphate (ortho, poly, DCP) to give season long supply.



Historic Comparison of Autumn and Spring P&K application in Winter Wheat (Yara internal data)

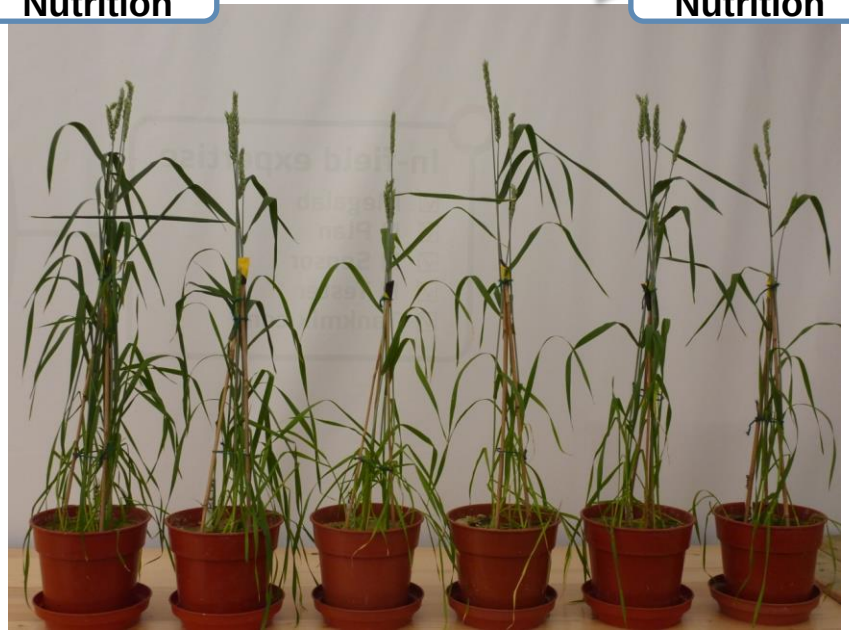


And of course include sulphur as it continues to give good results…4% in 2020 with YaraBela Axan



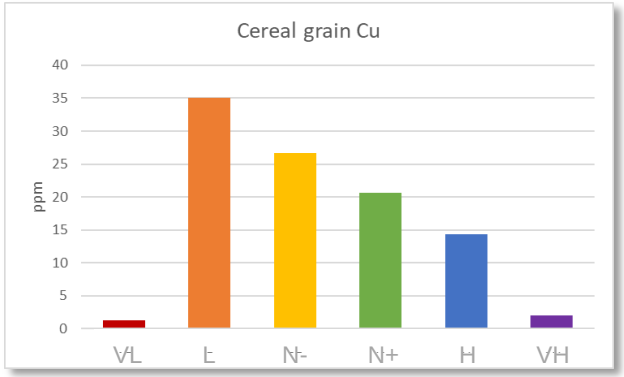
Visible symptoms are rarely evident in the field..

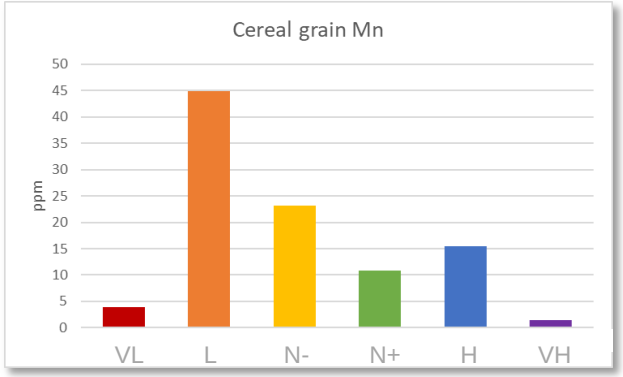
Complete Nutrition → **Incomplete Nutrition**

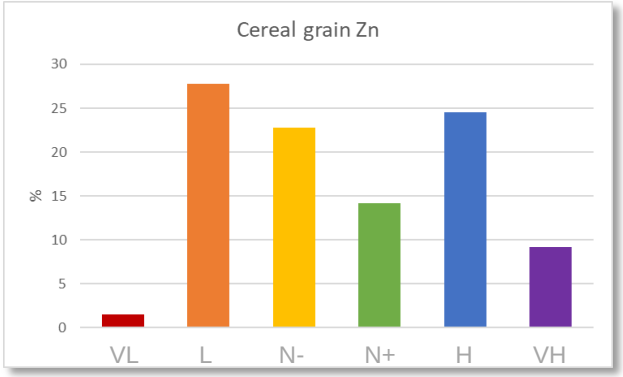


- Seen in isolation no immediately visible symptoms.
- Put alongside a healthy plant and the difference becomes clear.
- Note the lack of biomass as N,P,K,S and micros are removed from the nutrient solution = yield penalty.

Laboratory data indicates key nutrients deficiencies in Winter Wheat







The results from trials validating that these deficiencies are limiting yields

YaraVita GRAMITREL

YaraVita GRAMITREL is a flowable liquid fertiliser with a balanced combination of micronutrients including manganese, magnesium, copper and zinc for foliar application to cereals.

Combination of Key Nutrients

A balanced combination of essential nutrients for cereals

Highly concentrated micronutrient formulation

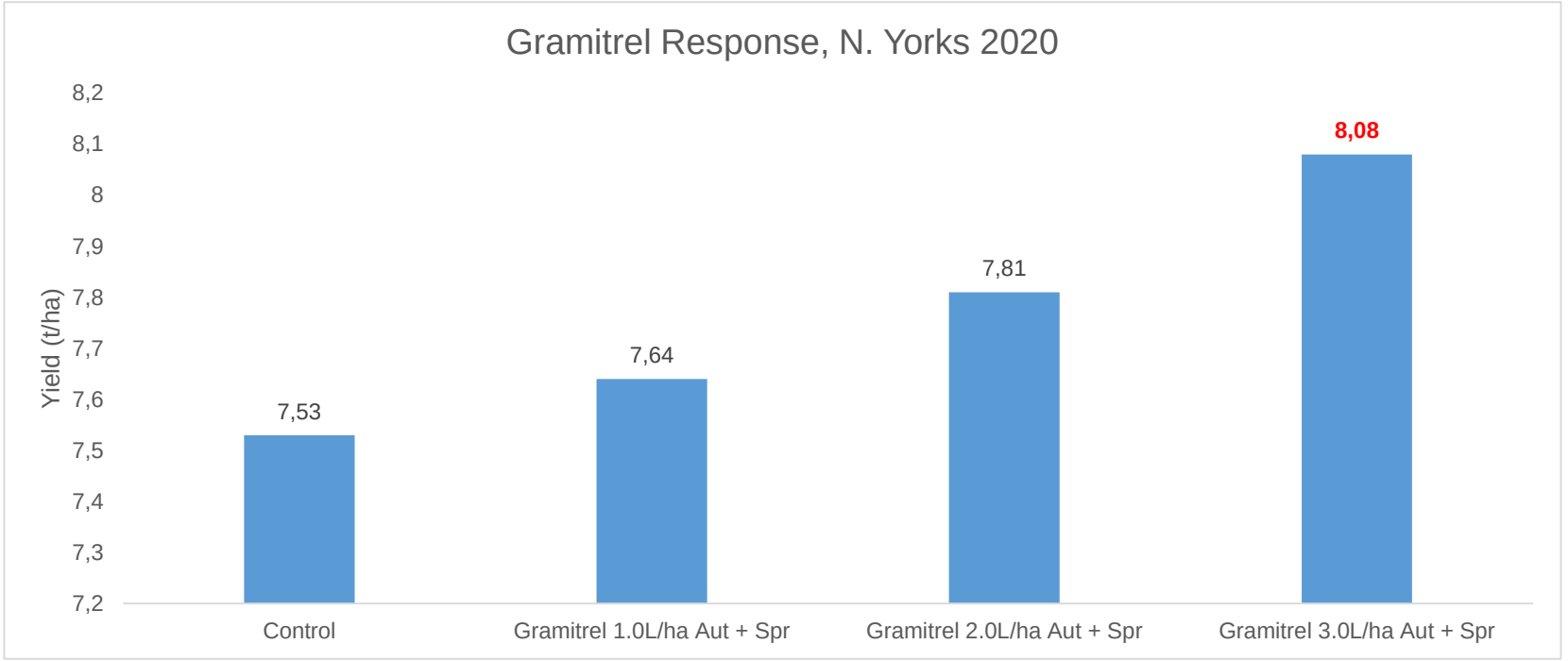
Stable suspension concentrate formulation

Widest Tank Mixability

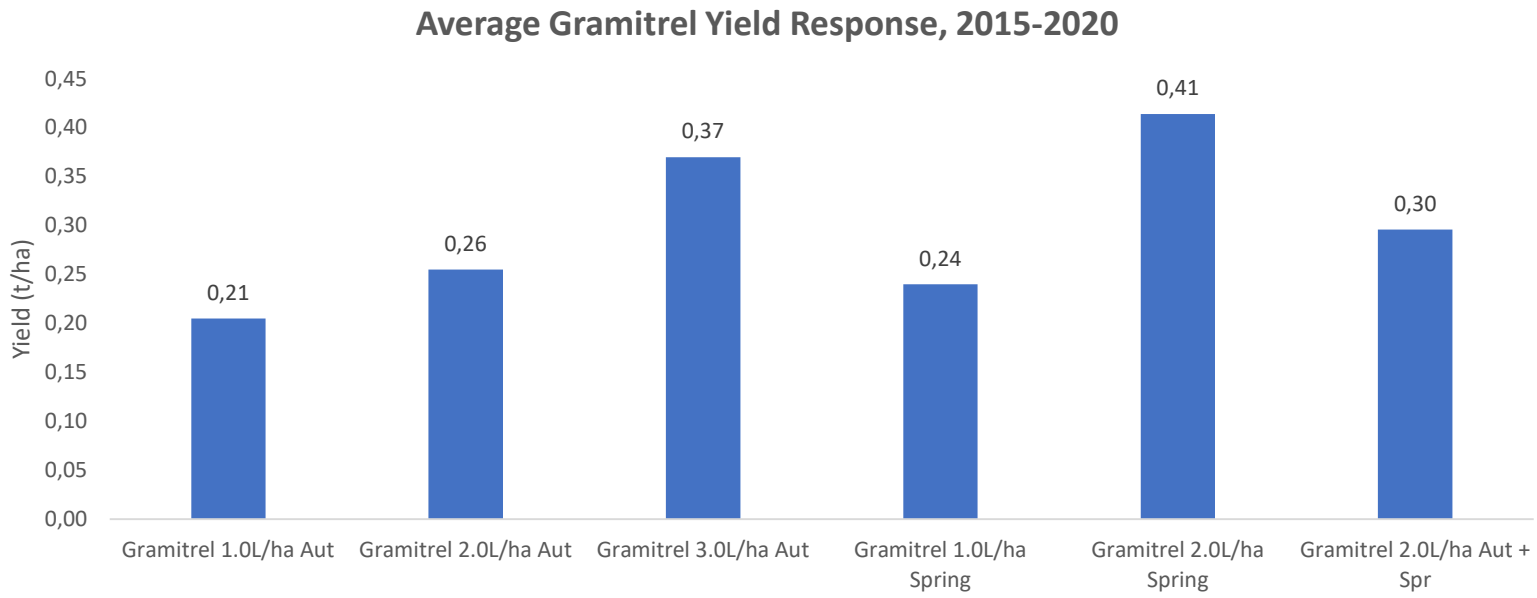
Tank mixes with almost all cereal pesticides

YaraVita Gramitrel Trials 2020

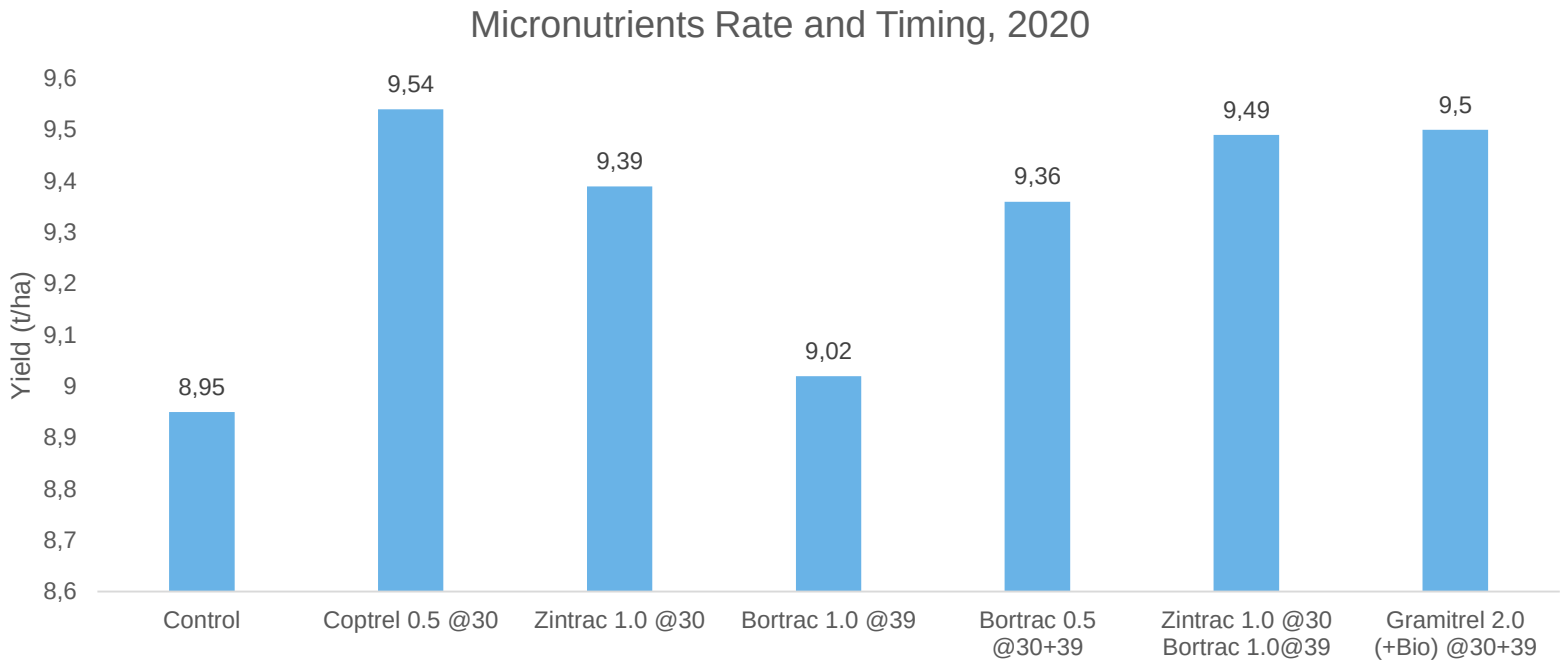
Oct Delivered £185 AHDB
Yield benefit gave £101.75



YaraVita Gramitrel Long-Term Data 2015-2020



Micronutrients Timing Trial 2020 - early is better!

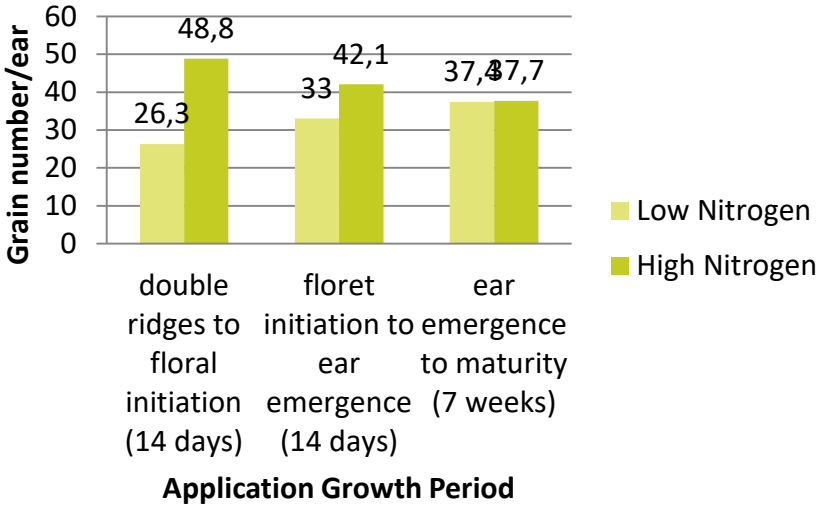


The next pillar to support high yields….

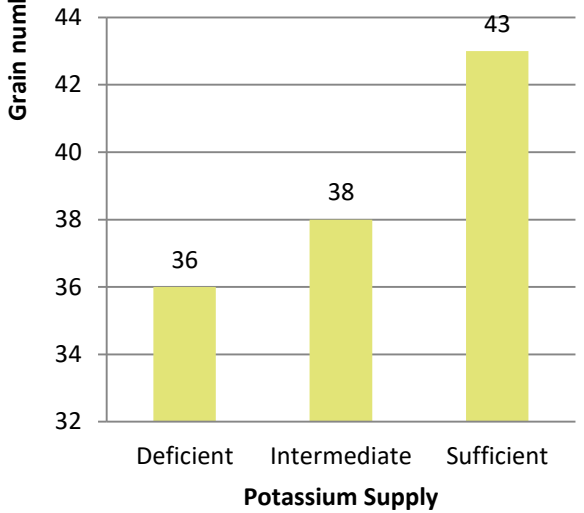
- Achieving high grain numbers / ha
- This is a combination of grain set per ear as well as ears per square metre.
- Key nutrients for good grain numbers per ear are:
  - Early nitrogen applications
  - Sufficient potassium
  - Manganese
  - Zinc
  - Copper
  - Boron

Nitrogen and potassium availability is important:

MEAN EFFECTS OF HIGH OR LOW NITROGEN IN THREE DEVELOPMENTAL PERIODS FROM DOUBLE RIDGES TO MATURITY (R. H. M. LANGER & F. K. Y. LIEW*)

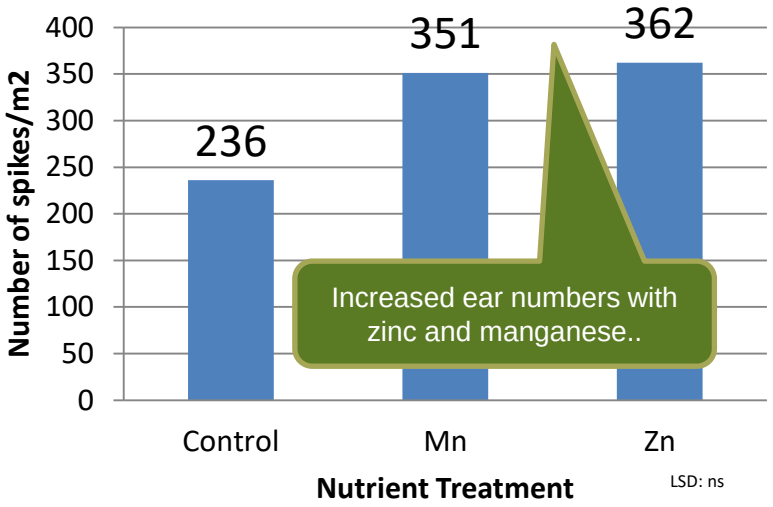


Effect of potassium supply on grain number per ear/spike(Ref:PDA).

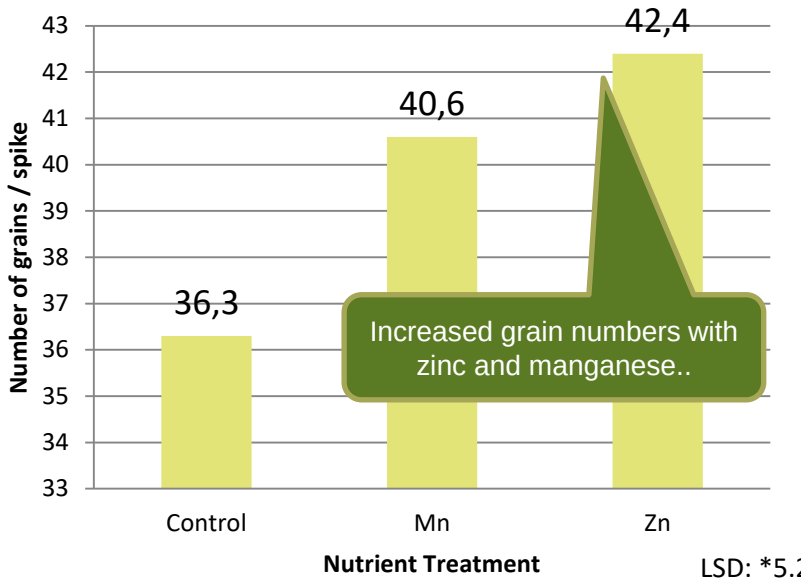


Early Manganese and Zinc are key to maintaining yield potential…

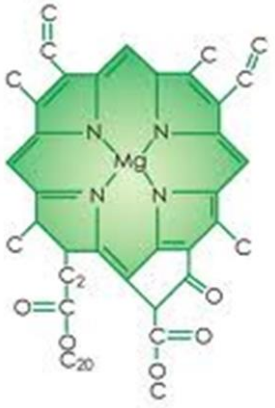
Effect of Mn and Zn fertilization on the number of ears (spikes) /m2 in wheat. (M.S. Zeidan et al, World J. Agric. Sci., 6 (6): 696-699, 2010)



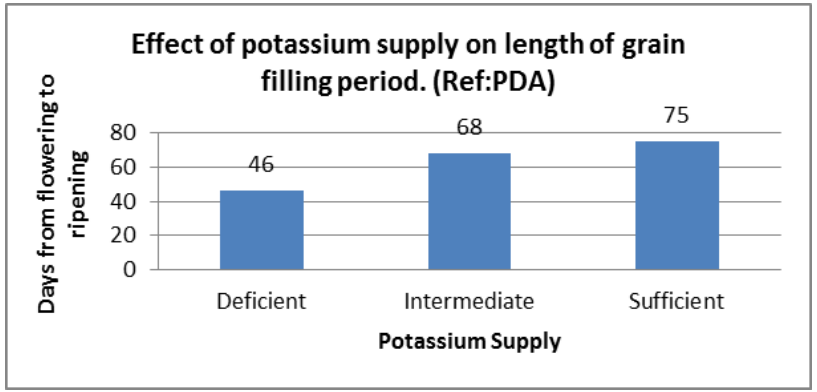
Effect of Mn and Zn fertilization on the number of grains /ear (spike) in wheat. (*M.S. Zeidan et al, World J. Agric. Sci., 6 (6): 696-699, 2010)*



For canopy duration then chlorophyll is also Magnesium rich, and Potassium maintains the canopy for longer..



Plant Chlorophyll



Summary

- Ensure:
  - Your strategy is targeted at producing high biomass with early spring nitrogen, sulphur and PK applications.
  - You monitor and manage all the key nutrients – macro and micro
  - Your strategy considers how best to achieve good grain set and therefore good grain numbers / ear.

Future Considerations

- The ‘Measures of Success’ are changing

- Clean Air Act is now upon us
  - Ammonia emissions are key to this with Ammonium Nitrate the product of choice and NOT urea.

- Carbon Footprints
  - Minimising carbon footprints will be a new measure so we have to consider:
    - Country of origin
    - Abated or non abated fertilizer
    - Green Ammonia becoming the feedstock within the decade.

World Records happen by design and not luck!

Ashburton, New Zealand--Farmer Eric Watson from Ashburton produced an incredible 17.398 tonnes per hectare wheat crop, beating his previous world record crop grown in 2017 of 16.791 tonnes per hectare and setting the new world record for the Highest wheat yield, according to the WORLD RECORD ACADEMY.

THANK YOU