

**Interreg**



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Central Baltic Programme

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**ReGen AGRI**

PANEL DISCUSSION · AGRICULTURAL ADVISORS

# ReGen AGRI

On-farm trials that cut leaching of N, P and K  
and lift nutrient use efficiency

Stefan Gernert · Jaan Ahlberg · Sander Hiire · Olivier de Schaetzen

THE PROJECT

# What ReGen AGRI sets out to do

**10–30%**

Target reduction  
in NPK fertilizer use

**4R**

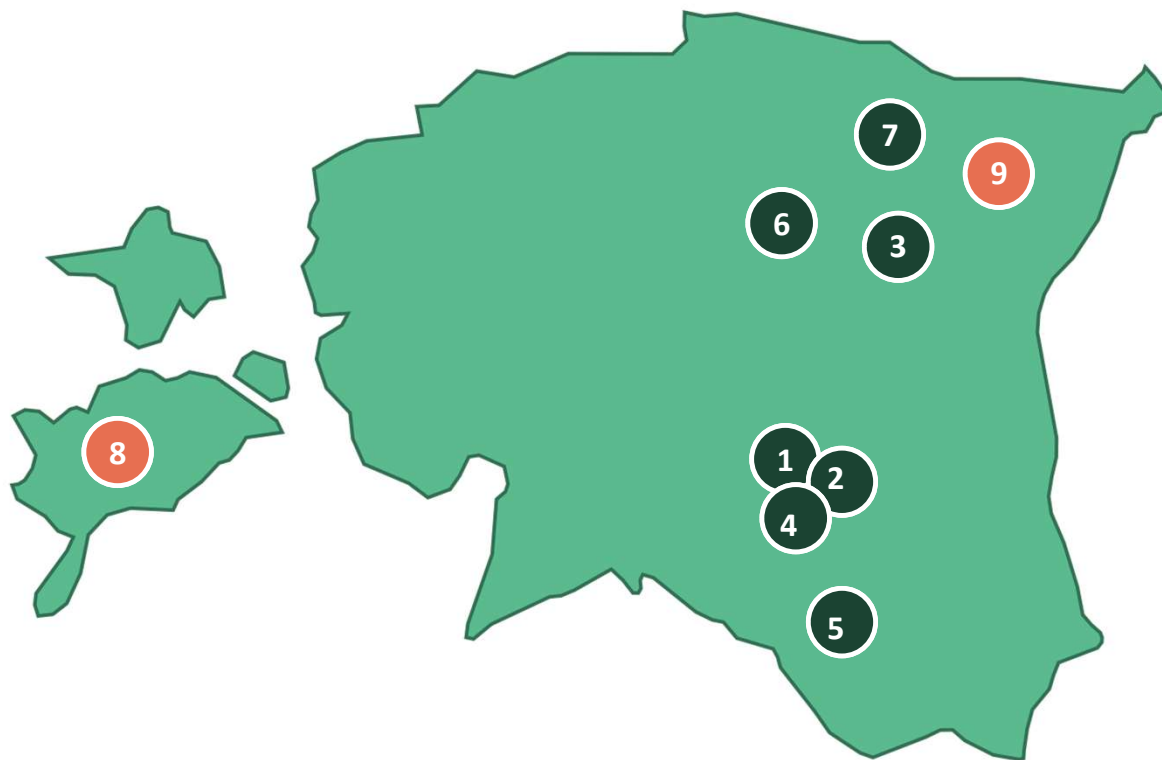
Strategy framework  
for nutrient stewardship

**6**

Measurement &  
calculation methods

Run **trials together with farmers** to test and demonstrate practices that **reduce leaching of N, P and K** while keeping yields.

# Nine trial farms across Estonia



## ARABLE (7)

- 1 Rannu Seeme
- 2 Soone Farm
- 3 Uuetoa talu
- 4 ATK Linavästrik
- 5 Vilsi
- 6 Kuie Põllum.
- 7 Miila Viss

## BEEF (2)

- 8 Saaremaa Aberdeen
- 9 Drovers

*Pin positions are approximate — adjust to exact farm locations.*

# Measurement & Calculation Methods

01

Ion Exchange Resin  
Bag Method

02

Plant Sap  
Testing

03

Grain/Yield Sampling &  
N Removal Calculation

04

Partial Factor  
Productivity Index

05

Soil Testing for  
Available N

06

Research  
Based Calculations

# Ion exchange resin (IER) bags

## PURPOSE

Measures nutrient leaching below the root zone in the soil.

## WHAT IS MEASURED

- $\text{NO}_3^-$  Nitrate
- $\text{NH}_4^+$  Ammonium
- $\text{PO}_4^{3-}$  Phosphate
- $\text{K}^+$  Potassium



## MEASUREMENT METHOD 02

# Plant sap testing

Mineral		Current Level	Optimum		
Sugars	%	1,0	0,5 - 2,8	1	2
	%	1,0			
pH		6,5	6,2 - 6,6	1	2
		6,2			
EC	mS/cm	16,2	14,3 - 17,9	1	2
	mS/cm	15,7			
K - Potassium	ppm	8350	6275 - 8050	1	2
	ppm	7577			
Ca - Calcium	ppm	1463	575 - 1500	1	2
	ppm	2159			
K / Ca		5,71		1	2
		3,51			
Mg - Magnesium	ppm	323	250 - 430	1	2
	ppm	360			
Na - Sodium	ppm	10	12 - 34	1	2
	ppm	14			
NH4 - Ammonium	ppm	328	280 - 655	1	2
	ppm	409			
NO3 - Nitrate	ppm	24	< 150	1	2
	ppm	<20			
N in Nitrate	ppm	5	< 34	1	2
	ppm	<5			
N - Total Nitrogen	ppm	5390	2600 - 4330	1	2
	ppm	4324			
Cl - Chloride	ppm	1931	970 - 2120	1	2
	ppm	1472			
S - Sulfur	ppm	538	360 - 590	1	2
	ppm	383			
P - Phosphorus	ppm	915	370 - 620	1	2
	ppm	565			
Si - Silicon	ppm	74,7	36,0 - 63,9	1	2
	ppm	42,7			
Fe - Iron	ppm	6,84	2,60 - 4,95	1	2
	ppm	5,88			
Mn - Manganese	ppm	5,33	3,60 - 8,20	1	2
	ppm	7,31			
Zn - Zinc	ppm	3,47	1,80 - 3,25	1	2
	ppm	3,38			
B - Boron	ppm	1,96	0,40 - 1,20	1	2
	ppm	0,83			
Cu - Copper	ppm	2,11	0,65 - 1,15	1	2
	ppm	0,98			
Mo - Molybdenum	ppm	1,20	0,05 - 0,20	1	2
	ppm	1,03			
Al - Aluminium	ppm	<0,50		1	2
	ppm	1,40			

Consult your advisor for appropriate fertilizer recommendations.

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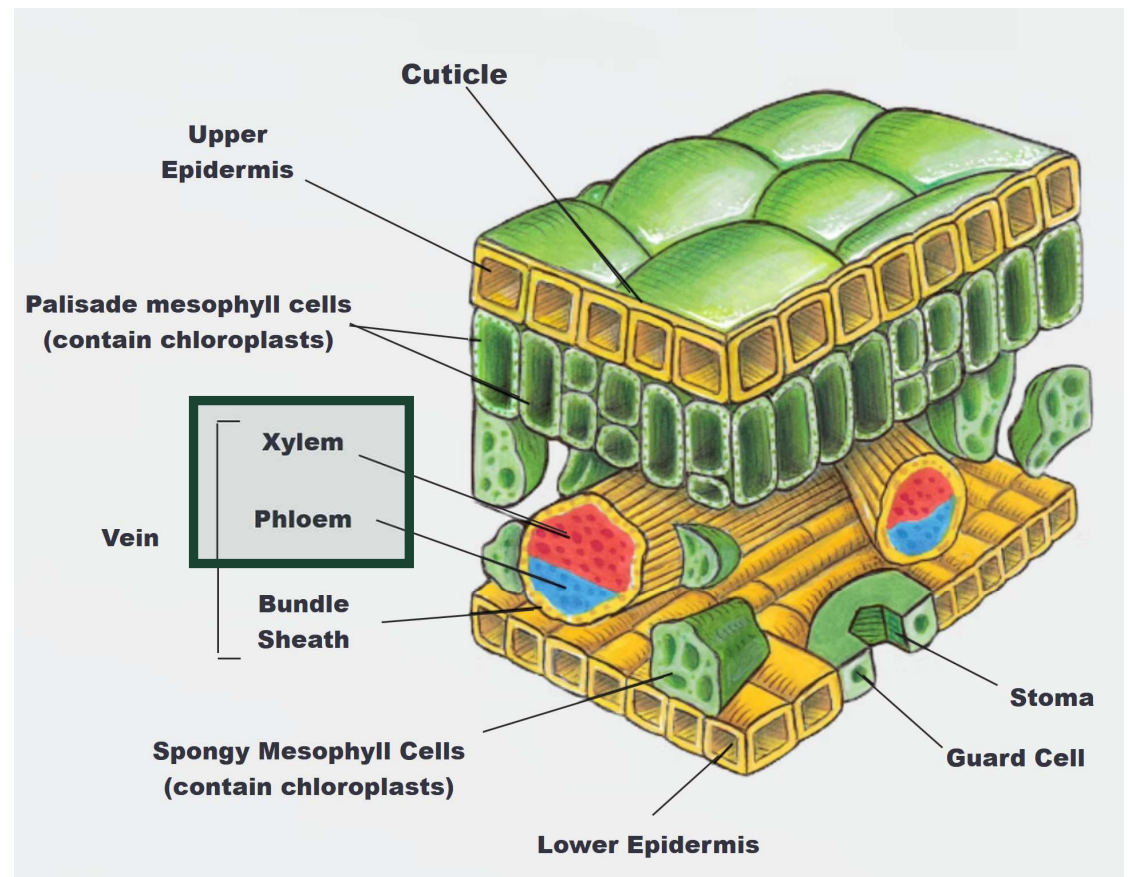
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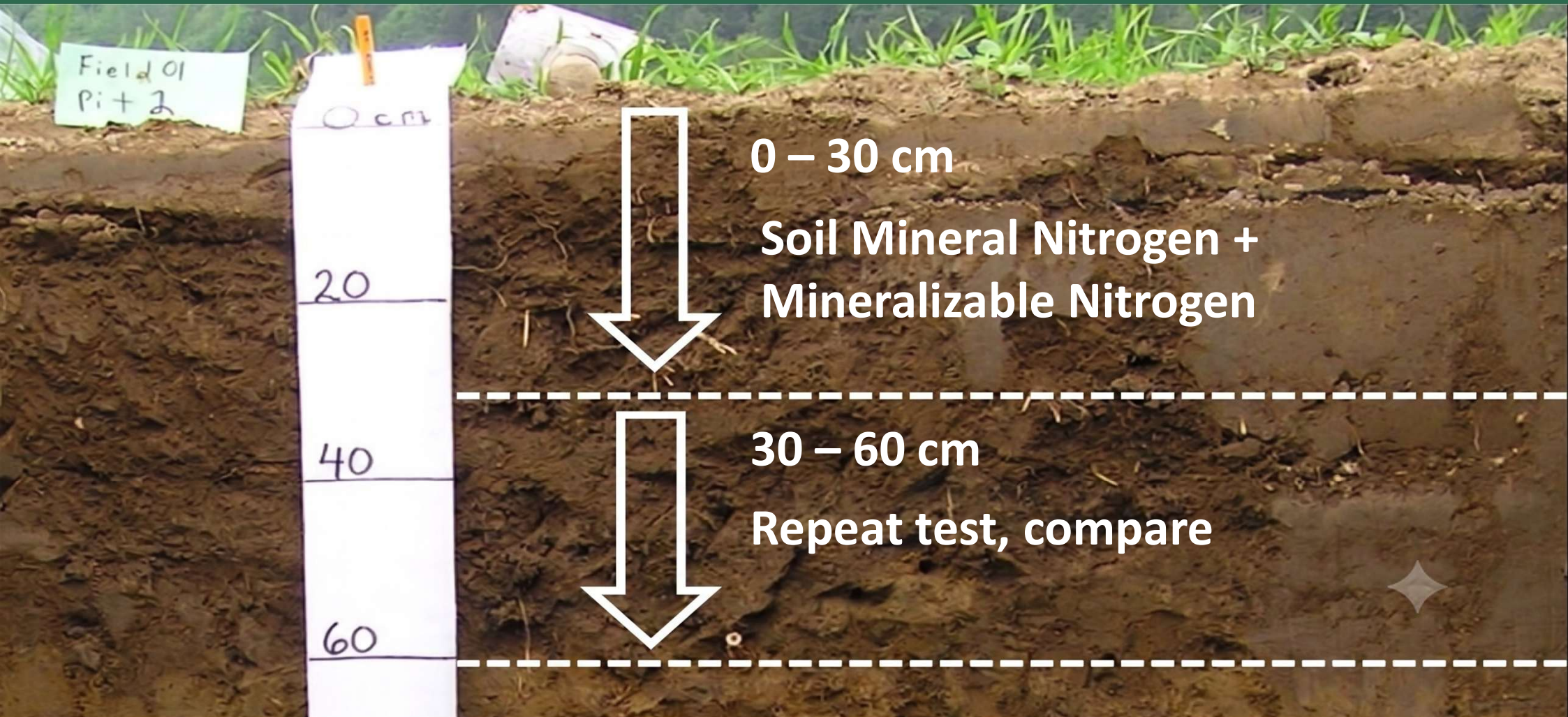
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Mo - Molybdenum	ppm	1,20	0,05 - 0,20	1	
	ppm	1,03		2	
Al - Aluminium	ppm	<0,50		1	
	ppm	1,40		2	

Consult your advisor for appropriate fertilizer recommendations.

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# Soil mineral N – SMN + HWEN



WHAT WE TRIAL

# Six strategies to trial on the farms

01

Baseline soil test and  
Soil Amendments

02

Split Application of  
Basal Fertilizers

03

Buffering and  
Complexing of Inputs

04

Foliar Nutrition based  
on Plant Sap Analysis

05

Cover Crops, Intercrops  
and Under Sowing

06

Reinvigorating Soil  
Microbiology

PANEL DISCUSSION

# The practices, in depth

Why use it · how it works in practice · what to watch for · effect on learning

# Soil baseline testing & amendments

Sample Name: N1 Pea 2.5 1.5      Analysis Number: 614305      Sampling Depth: 15 cm      Date:  
 Extraction method: See Agrolab Test Report      Sampling Date: 15.01.2026      Soil Type: schwach lehmiger Sand

SOIL BASIC PROPERTIES	
Current Exchange Capacity [mmol/100g]	5.2 Measure of water and nutrient retention capacity and soil vitality
Total Exchange Capacity [mmol/100g]	15.0 Cation exchange capacity at neutral pH, including the acid adhered to the exchanger
pH value (H <sub>2</sub> O)	6 pH value available to soil biology. Target: 6.5
pH value (CaCl <sub>2</sub> )	5.3 The difference between pH values indicates the soil's buffering capacity → Target: < 0.5
Organic Matter [%]	1.1 An Organic Matter content of at least 5% is recommended.*
ENR N [kg/ha]	61 Estimated nitrogen release during the growing season → Determine current demand and supplement through fertilization.

### BASE SATURATION ON CURRENT EXCHANGE CAPACITY

	ACTUAL [%]	TARGET [%]
Calcium (Ca)	68.40	64 +/- 4
Magnesium (Mg)	6.60	16 +/- 2
Potassium (K)	4.60	6 +/- 1
Sodium (Na)	<0.2	2 +/- 1
H+	15	10

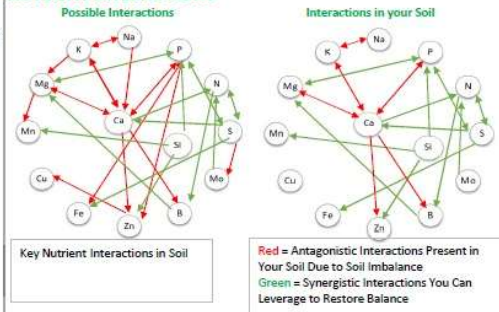
### NUTRIENT BALANCES

Nitrogen	Phosphorus
Sulfur	Phosphorus
Zinc	Phosphorus Mehlich 3
Phosphorus CAL	Calcium
Boron	Potassium Mehlich 3
Potassium	Iron
Manganese	

### NUTRIENT LEVELS

Macronutrients	Requirement in kg pure nutrient/ha
Sulfur (S)	141
Phosphorus Mehlich-3 (P)	106
Calcium (Ca)	2676
Magnesium (Mg)	545
Potassium (K)	643
Sodium (Na)	72
Boron (B)	4.1
Iron (Fe)	-157
Manganese (Mn)	-105.8
Copper (Cu)	6.8
Zinc (Zn)	12.3
Cobalt (Co)	-14.6
Selenium (Se)	1.9
Molybdenum (Mo)	0.7

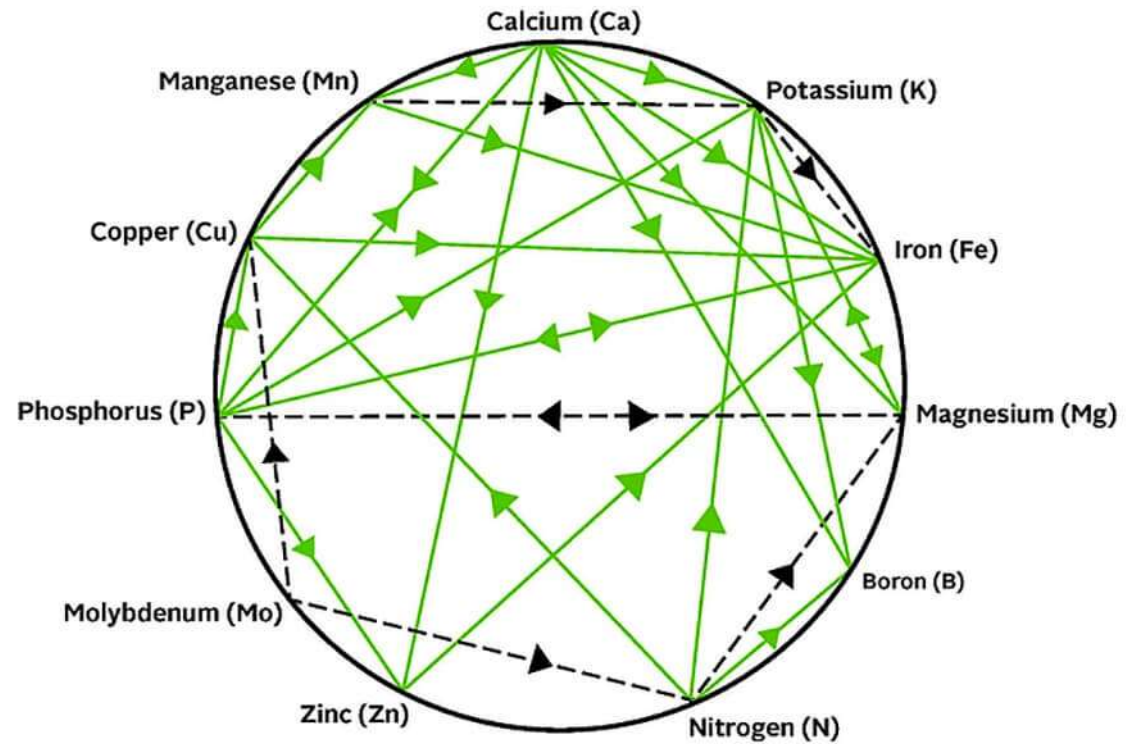
### NUTRIENT INTERACTIONS



LUFA - Standard Analysis	mg/100g	Content class ("C" is target)
Available Phosphorus (P2O5-CAL)	2.40	A
Available Potassium (K2O-CAL)	8.90	B
Available Magnesium (CaCl2)	3.50	C

Large difference between CEC\_actual and CEC\_potential = Unused sorption potential!  
 Nitrogen efficiency (protein synthesis) is limited by molybdenum deficiency.

The interpretation of the raw data and the corresponding recommendations were exclusively prepared by Bodenbalance - Kohls GbR.



# Soil baseline testing & amendments

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Organic Matter [%] 1.1 An Organic Matter content of at least 5% is recommended.\*

ENR N [kg/ha] 61. Estimated nitrogen release during the growing season → Determine current demand and supplement through fertilization.

Mehlich BaCl - E

\*Applie

### BASE SATURATION ON CURRENT EXCHANGE CAPACITY

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H+	15	10

### NUTRIENT BALANCES

Nitrogen		Carbon
Sulfur		Phosphorus
Zinc		Phosphorus
Phosphorus CAL		Phosphorus Mehlich 3
Boron		Calcium
Potassium		Potassium Mehlich 3
Manganese		Iron

### NUTRIENT LEVELS

**Macronutrients**

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Sulfur (S)	141
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**Microelements**

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Iron (Fe)	-157
Manganese (Mn)	-105.8
Copper (Cu)	6.8
Zinc (Zn)	12.3
Cobalt (Co)	-14.6
Selenium (Se)	1.9
Molybdenum (Mo)	0.7

### NUTRIENT INTERACTIONS

**Possible Interactions**

**Interactions in your Soil**

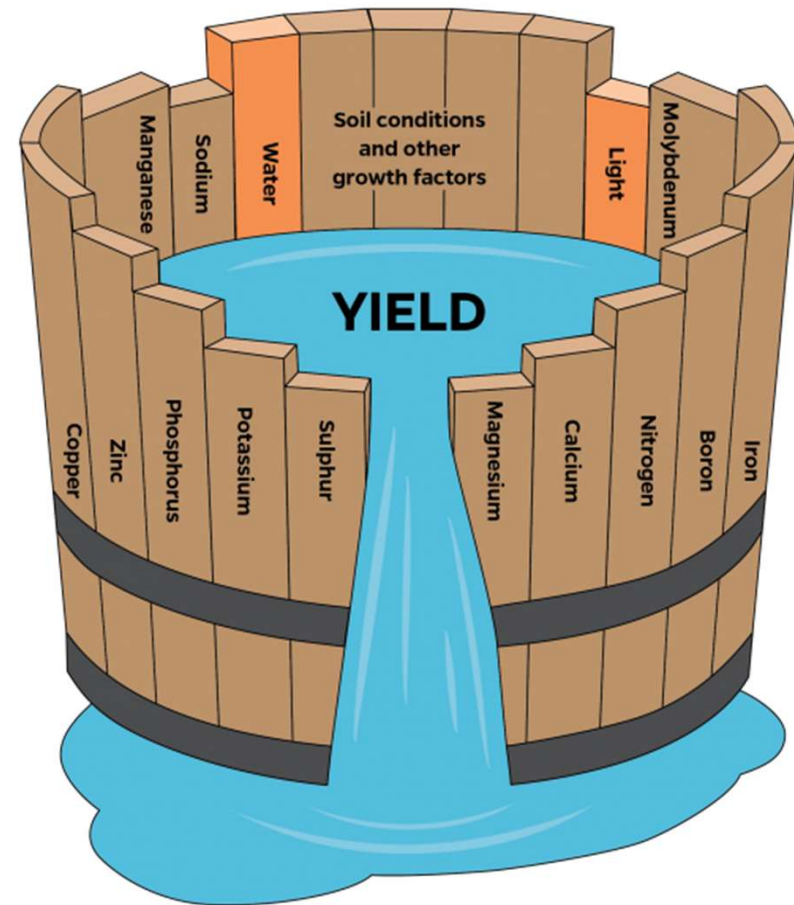
**Key Nutrient Interactions in Soil**

Red = Antagonistic Interactions Present in Your Soil Due to Soil Imbalance  
Green = Synergistic Interactions You Can Leverage to Restore Balance

LUFA - Standard Analysis

mg/100g	Content class ("C" is target)
Available Phosphorus (P2O5-CAL)	2.40 A
Available Potassium (K2O-CAL)	8.90 B
Available Magnesium (CaCl2)	3.50 C

Large difference between CEC\_actual and CEC\_potential = Unused sorption potential!  
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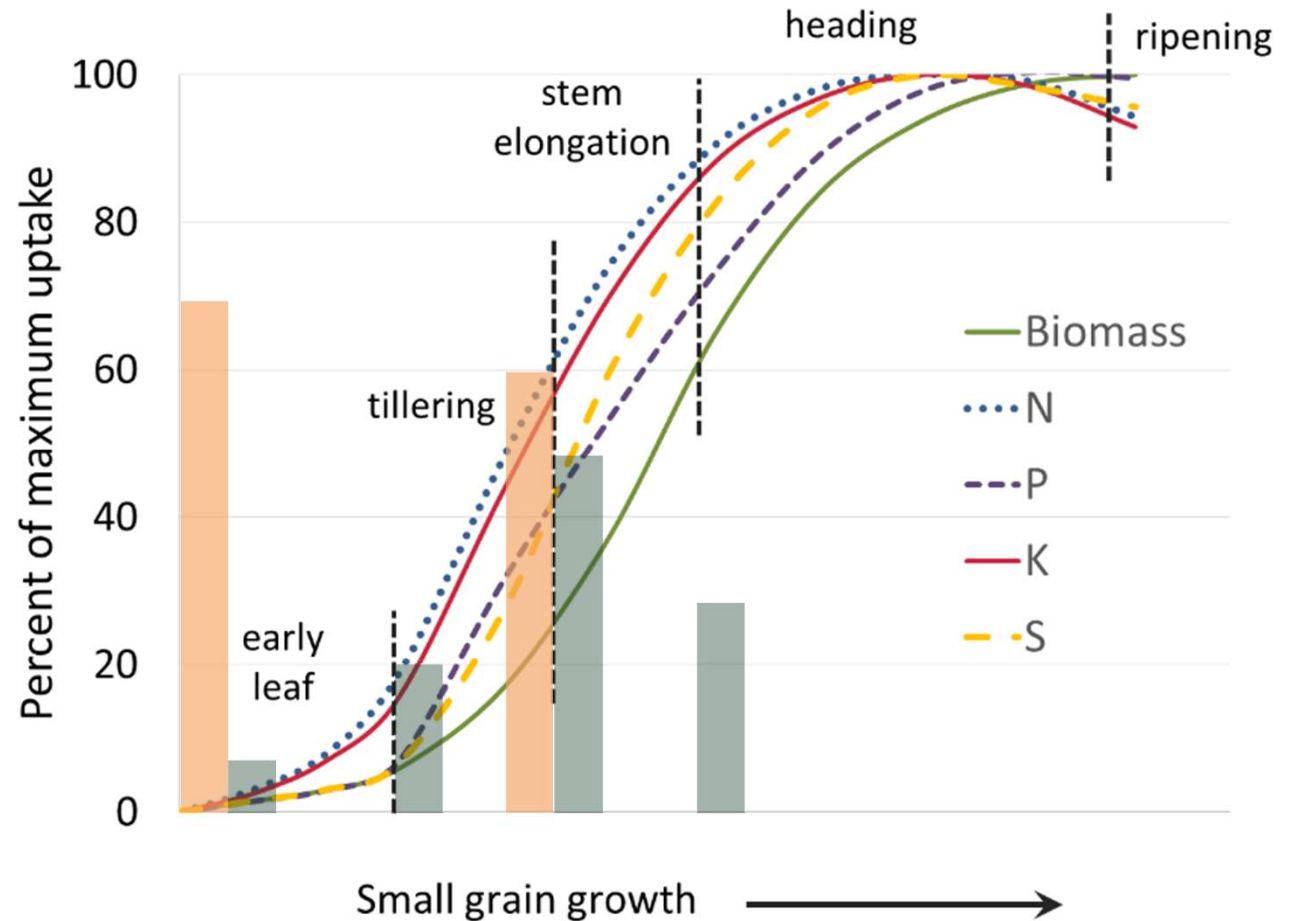
# Split application of basal fertiliser

## PURPOSE

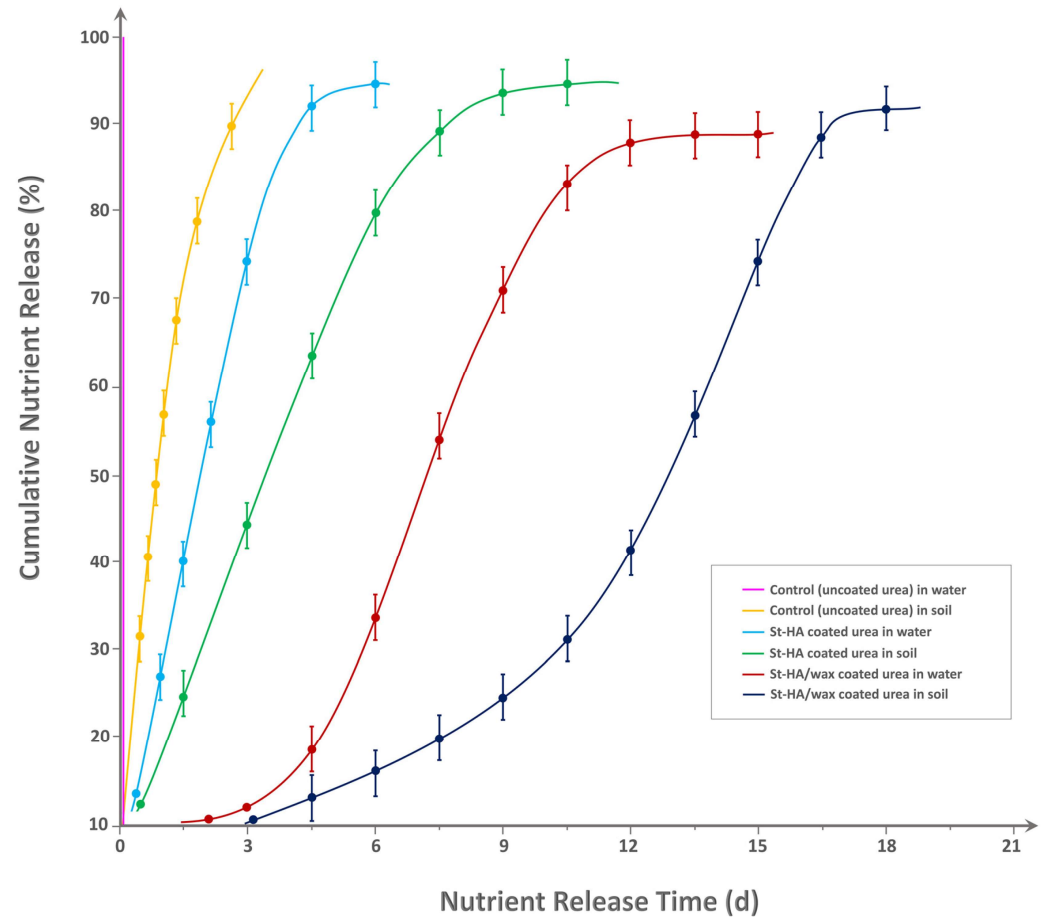
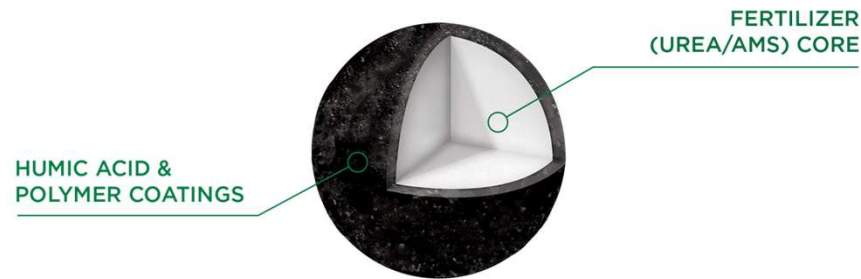
Match the nutrient supply with the actual demand of the crop.

## BENEFITS

- Improved nutrient uptake
- Reduced losses of nutrients



# Buffering & complexing of inputs



PRACTICE · DISCUSSION

# Cover crops, undersowing & N-fixers

Crimson Clover  
(*Trifolium incarnatum*)

Hairy Vetch  
(*Vicia villosa*)

Red Clover  
(*Trifolium pratense*)

Alfalfa  
(*Medicago sativa*)

Yellow Blossom  
Sweet Clover  
(*Melilotus officinalis*)

Sunn Hemp  
(*Crotalaria juncea*)

Annual Ryegrass  
(*Lolium multiflorum*)

Triticale  
(x *Triticosecale*)

Sorghum  
Sudangrass  
(*Sorghum bicolor*  
x *S. sudanense*)

Tillage Radish  
(*Raphanus sativus*)



PRACTICE · DISCUSSION

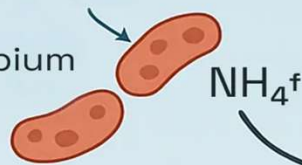
# Cover crops, undersowing & N-fixers



# Reinvigorating soil microbiology

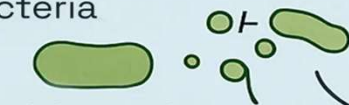
## Nitrogen Acquisition

Symbiotic Diazotrophs  
Rhizobium,  
Bradyrhizobium  
Frankia



## Phosphorus Acquisition

Phosphate-Solubilizing  
Bacteria  
Arbuscular  
Mycorrhizal Fungi  
Organic  
Acids,  
Phosphatases



Free-Living  
Plant Growth-Promoting  
Rhizobacteria

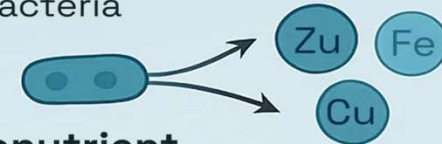


Plant Growth  
Regulators



## Micronutrient Acquisition

Siderophore-Producing  
Bacteria



## Micronutrient Acquisition

Chelate  
Chelate  
Solubilize



Plant Growth  
Regulators



# Q & A

Questions & discussion with the audience