

Sustaining the future.



# WE'RE ABOUT BEST PRACTICE

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25 October 2018  
Athens, Greece



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# AGENDA

**1. Current fertilizer strategies**

**2. Opportunities for improved practice with POLY4**

**3. Outcomes for improved quality**



## DEMAND AND PROVISIONS

### Nitrogen

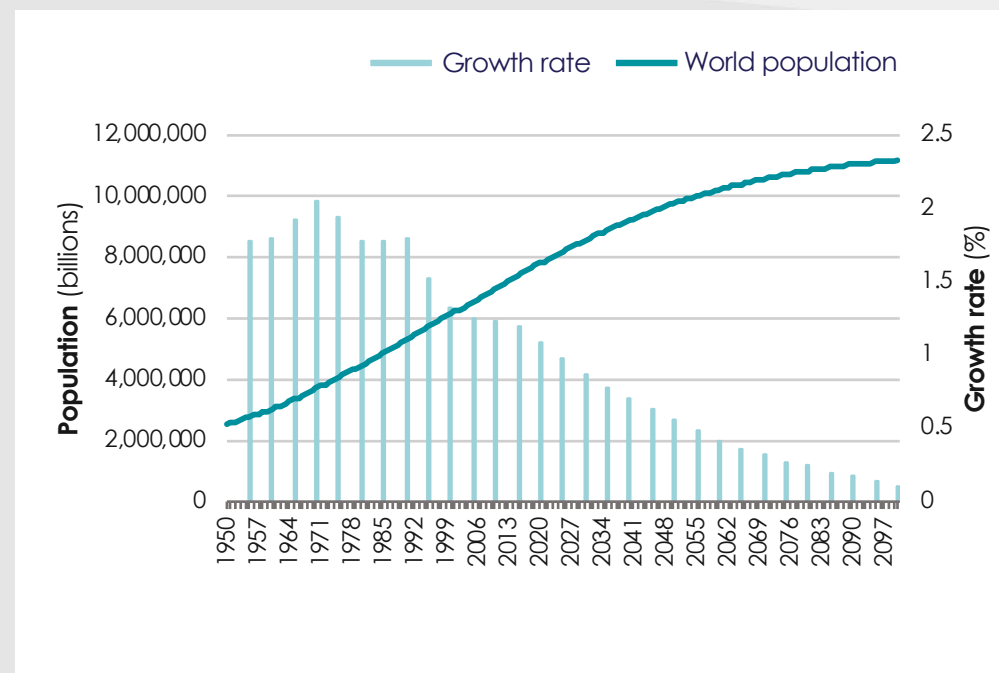
- Ubiquitous ~ 78% v/v atmosphere
- Production may become strategic
- EU: biggest natural gas user, costs forecast to double

### Phosphorus

- Limited countries own mineral resources
- Finite and strategic resource
- EU: dependent on external sources with forecasted 25% availability decrease, quality issues

### Potassium

- Two-thirds of the world production is in three countries (Canada, Russia and Belarus)
- Eight companies control 80% of the production
- EU: partially self-sufficient with supplies from UK, Germany, France and Spain

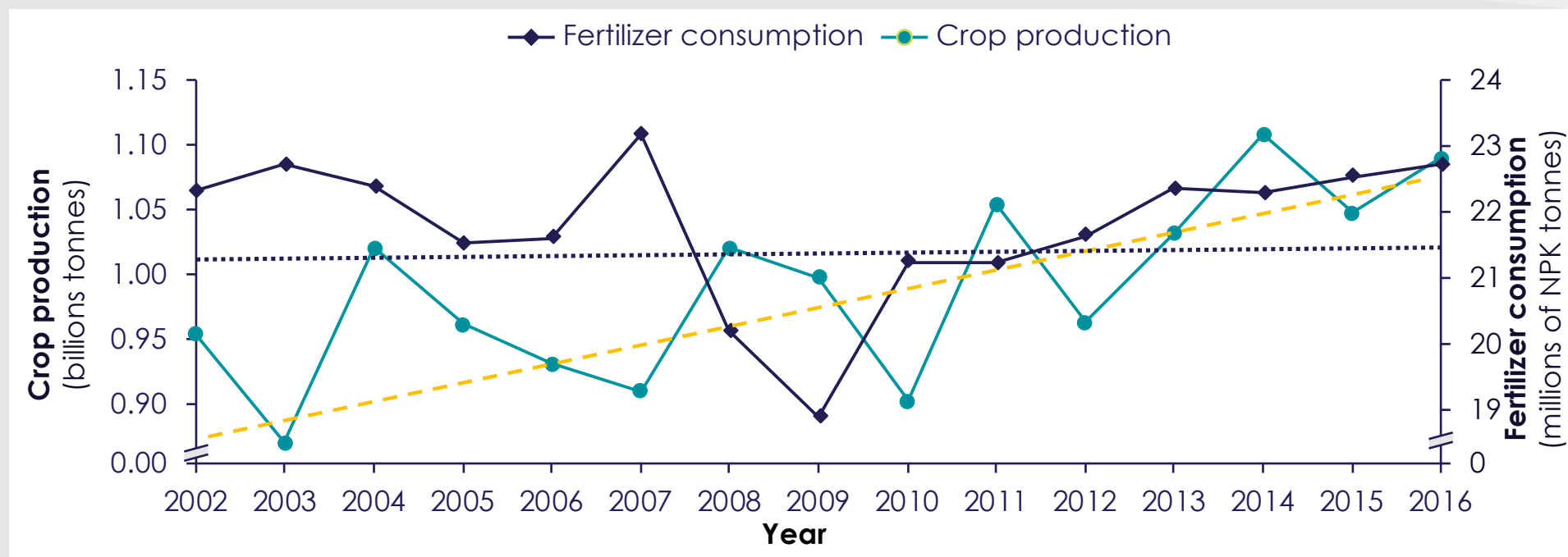


### KEY TAKEAWAY:

SUPPLY RISKS, DEPLETION OF NON-RENEWABLE RESOURCES



## CURRENT TREND IN FERTILIZER USE



EU exhibits improvement in fertilizer use efficiency but is also affected by:

- Changes in dietary habits, biofuels production and Genetic improvements elevate output
- NPK use is static
- Are we depleting the soil resource?

## CURRENT CONCERNS TO ACCOUNT FOR

Crop requirements for food production

Geostrategic elements in a more uncertain global political situation

Application efficiencies

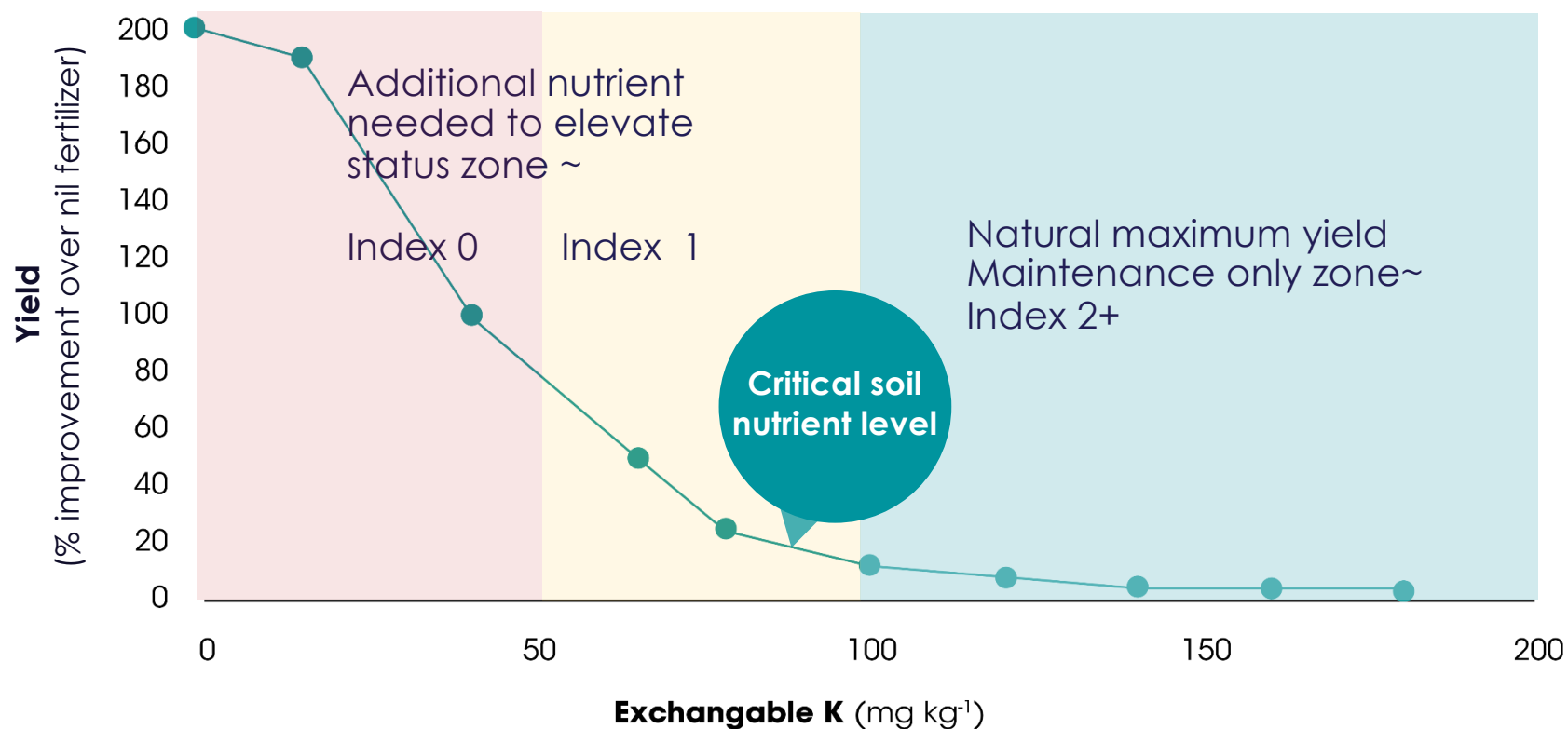
Soil rehabilitation

Environmental impacts

**KEY TAKEAWAY:**

CONSIDER A HOLISTIC APPROACH FOR LONG-TERM FOOD SECURITY

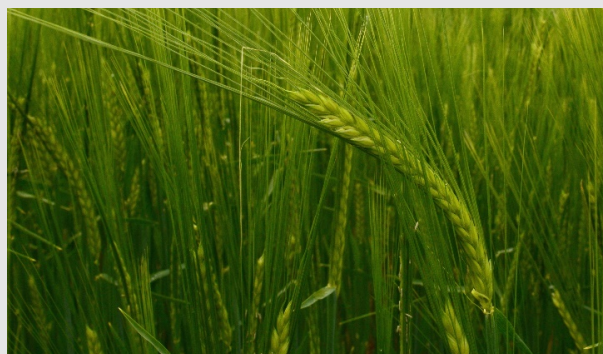
## FERTILIZER RATE CHANGES WITH SOIL SUPPLY CAPACITY



**KEY TAKEAWAY:**

**WHEN NATURAL YIELD PEAKS WE ONLY REQUIRE MAINTENANCE  
BECAUSE MORE DOESN'T WORK**





	P or K Index			
	0	1	2	3 and higher
	kg/ha			
Straw ploughed in/incorporated				
Winter wheat, winter barley (8 t/ha)				
Phosphate (P <sub>2</sub> O <sub>5</sub> )	120	90	60	0
Potash (K <sub>2</sub> O)	105	75	45 (2-) 20 (2+)	0
Spring wheat, spring barley, rye, triticale (6 t/ha)				
Phosphate (P <sub>2</sub> O <sub>5</sub> )	105	75	45	0
Potash (K <sub>2</sub> O)	95	65	35 (2-) 0 (2+)	0
Winter and spring oats (6 t/ha)				
Phosphate (P <sub>2</sub> O <sub>5</sub> )	105	75	45	0
Potash (K <sub>2</sub> O)	95	65	35 (2-) 0 (2+)	0
Straw removed				
Winter wheat, winter barley (8 t/ha)				
Phosphate (P <sub>2</sub> O <sub>5</sub> )	125	95	65	0
Potash (K <sub>2</sub> O)	145	115	85 (2-) 55 (2+)	0
Spring wheat, spring barley, rye, triticale (6 t/ha)				
Phosphate (P <sub>2</sub> O <sub>5</sub> )	110	80	50	0
Potash (K <sub>2</sub> O)	130	100	70 (2-) 40 (2+)	0
Winter and spring oats (6 t/ha)				
Phosphate (P <sub>2</sub> O <sub>5</sub> )	115	85	55	0
Potash (K <sub>2</sub> O)	165	135	105 (2-) 75 (2+)	0

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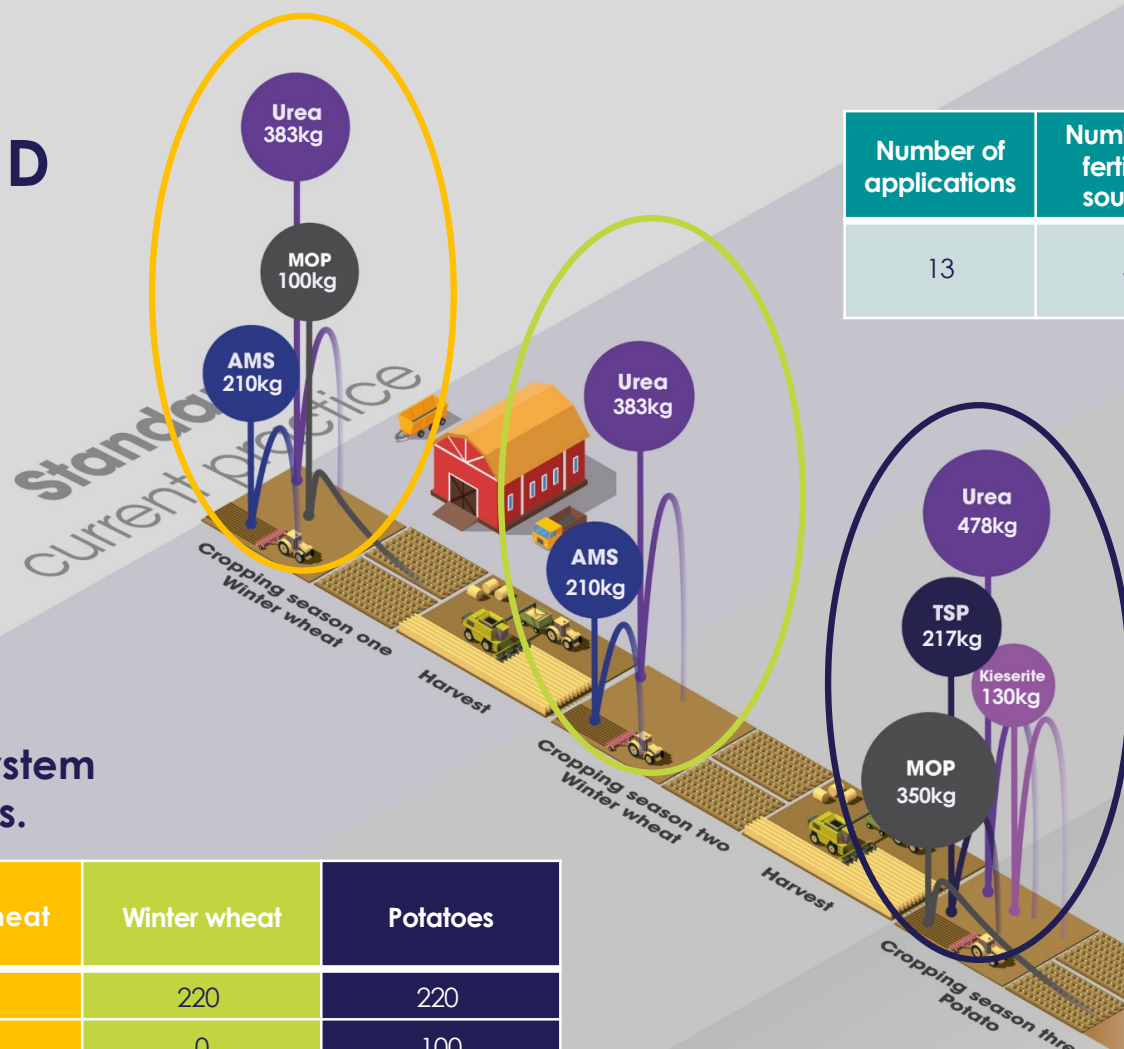
## EFFICIENT AND FLEXIBLE

Number of applications	Number of fertilizer sources	Cost (US\$/ha)	Output (US\$/ha)
13	5	208	4,608

Case study:  
rotation cropping system  
across three seasons.

Nutrients applied (kg ha <sup>-1</sup> )	Winter wheat	Winter wheat	Potatoes
N	220	220	220
P <sub>2</sub> O <sub>5</sub>	0	0	100
K <sub>2</sub> O	60	0	210
CaO	0	0	43
MgO	0	0	33
S	50	50	26
Cl <sup>-</sup>	48	0	168

Notes: 1) A review of policy changes over a wheat – wheat – potatoes rotation. Fertilizer plan considers WW needs 30 K<sub>2</sub>O ha<sup>-1</sup>, potatoes 210 K<sub>2</sub>O ha<sup>-1</sup>, POLY4 supplies all of the crop's K, Mg and S need. Application, timing and crop responses as per trial results: 17000-ASA-17010-14, 18000-SGS-18010-14, 49000-PUL-49010-16, 22000-MAC-22010-15. Crop yield response v standard based on +3% average yield improvement on winter wheat and +5% on potato.



Performance consideration:



Yield

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## EFFICIENT AND FLEXIBLE

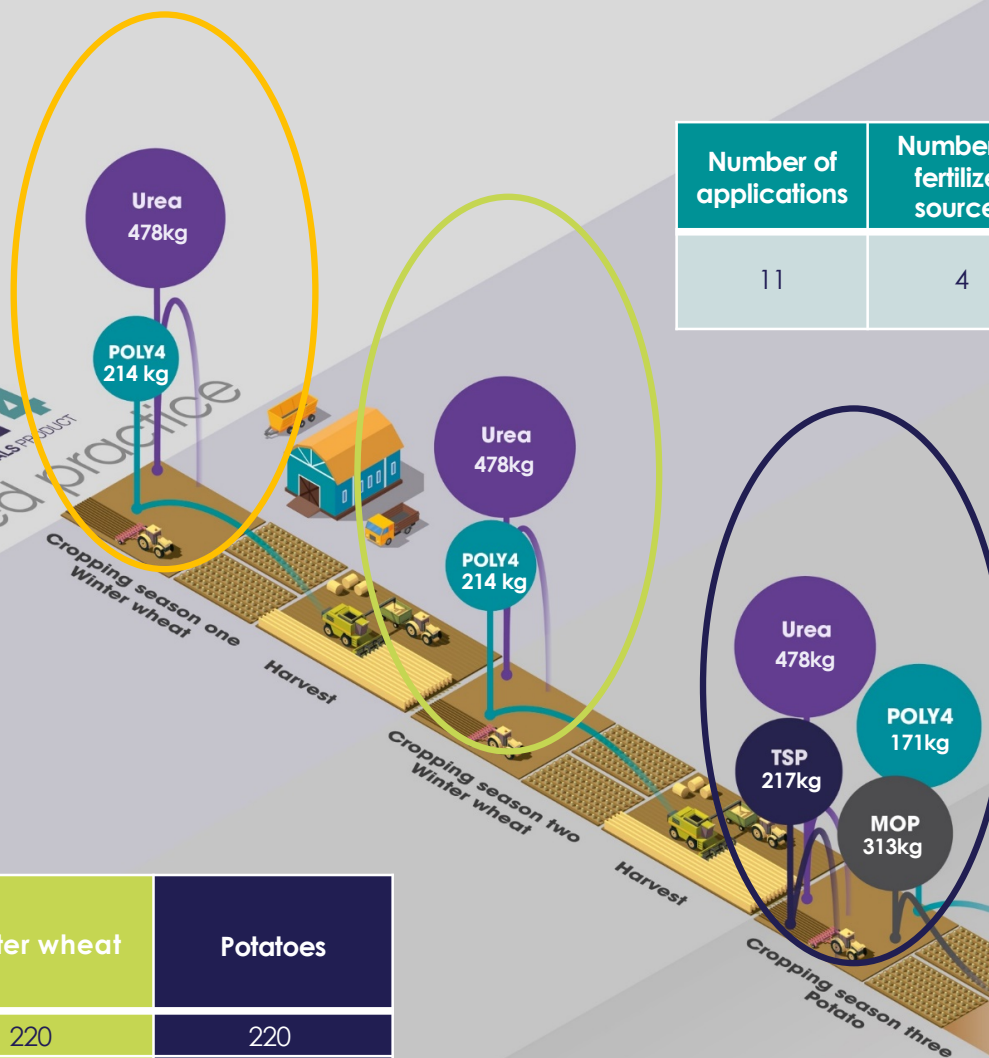


**POLY4**  
A SIRIUS MINERALS FERTILISER  
improved practice

Number of applications	Number of fertilizer sources	Cost (US\$/ha)	Output (US\$/ha)
11	4	210	4811

**Case study:**  
rotation cropping system  
across three seasons.

Nutrients applied (kg ha <sup>-1</sup> )	Winter wheat	Winter wheat	Potatoes
N	220	220	220
P <sub>2</sub> O <sub>5</sub>	0	0	100
K <sub>2</sub> O	30	30	210
CaO	36	36	72
MgO	13	13	10
S	41	41	32
Cl <sup>-</sup>	6	6	155



**Performance consideration:**



**Yield**

Notes: 1) A review of policy changes over a wheat – wheat – potatoes rotation. Fertilizer plan considers WW needs 30 K<sub>2</sub>O ha<sup>-1</sup>, potatoes 210 K<sub>2</sub>O ha<sup>-1</sup>, POLY4 supplies all of the crop's K, Mg and S need. Application, timing and crop responses as per trial results: 17000-ASA-17010-14, 18000-SGS-18010-14, 49000-PUL-49010-16, 22000-MAC-22010-15. Crop yield response v standard based on +3% average yield improvement on winter wheat and +5% on potato.



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## EFFICIENT AND FLEXIBLE



**POLY4**  
A SIRIUS MINERALS PRODUCT

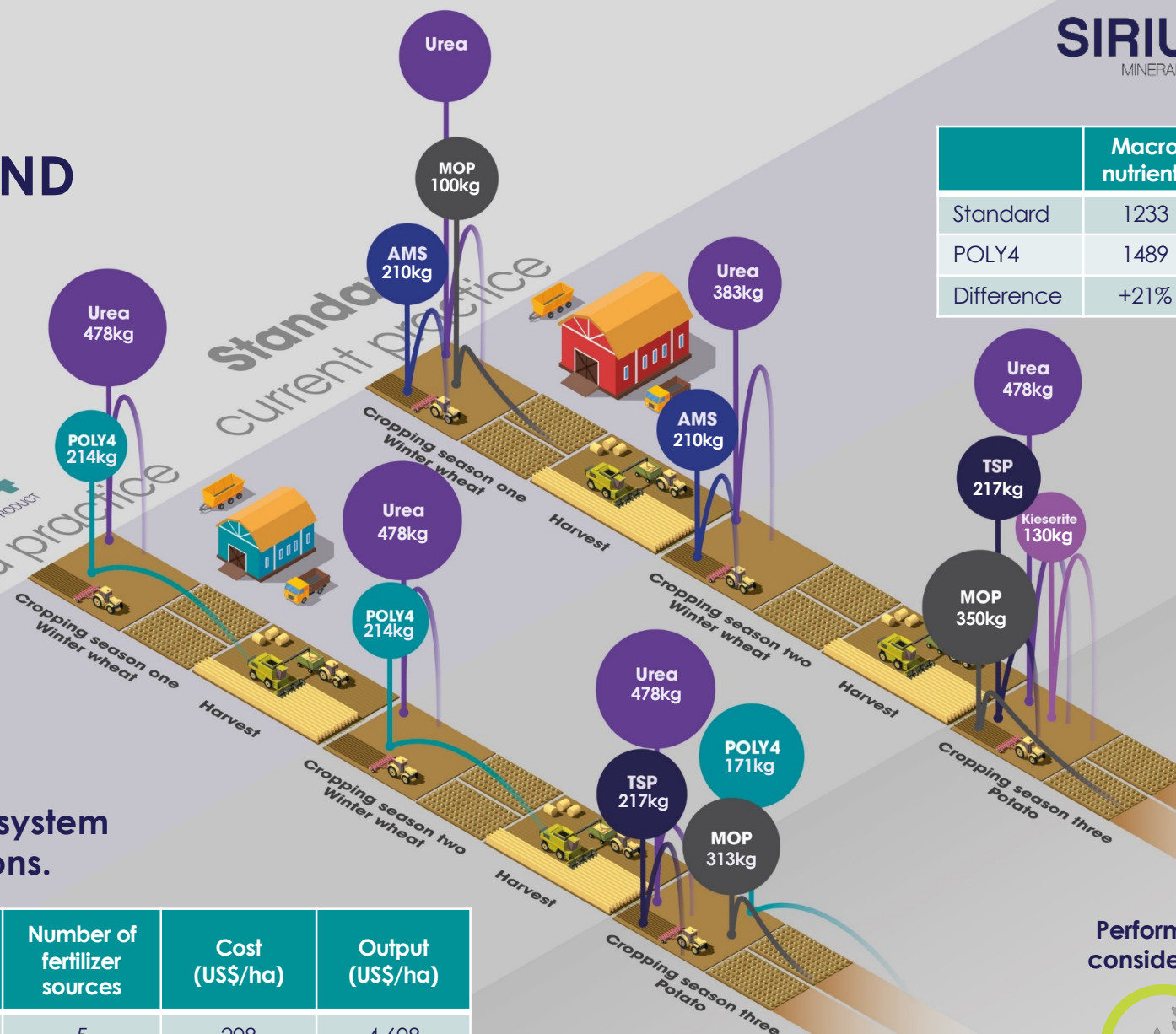
improved practice

Standard  
current practice

**Case study:**  
rotation cropping system  
across three seasons.

	Number of applications	Number of fertilizer sources	Cost (US\$/ha)	Output (US\$/ha)
Standard	13	5	208	4,608
POLY4	11	4	210	4,811
Difference	-2	-20%	+2	+203

	Macro nutrients	Chlorides
Standard	1233	216
POLY4	1489	168
Difference	+21%	-22%



Performance  
consideration:



**Yield**

Notes: 1) A review of policy changes over a wheat – wheat – potatoes rotation. Fertilizer plan considers WW needs 30 K<sub>2</sub>O ha<sup>-1</sup>, potatoes 210 K<sub>2</sub>O ha<sup>-1</sup>, POLY4 supplies all of the crop's K, Mg and S need. Application, timing and crop responses as per trial results: 17000-ASA-17010-14, 18000-SGS-18010-14, 49000-PUL-49010-16, 22000-MAC-22010-15. Crop yield response v standard based on +3% average yield improvement on winter wheat and +5% on potato.

## EFFECTIVE BUT INEFFICIENT INDUSTRY APPROACH

### What we do

Assess soil nutrient status

Account for crop residue values

Consider application timing

Consider soil CEC

Talk about “sustainability”

### What we are missing

Supply rate from the soil

Source efficiency of nutrient capture

Accounting for residual soil nutrient status from different sources

Individual product application timing

Antagonism/disruption by application of different nutrient source

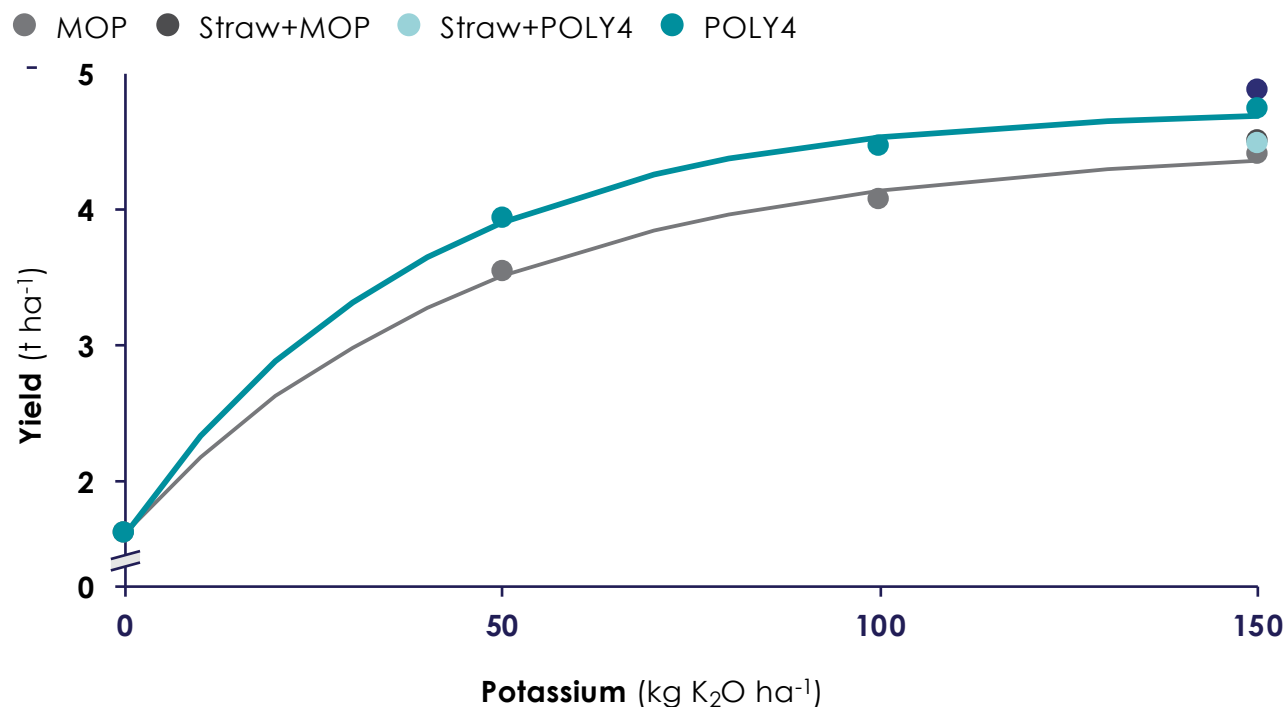
Replacing nutrient offtake for all nutrients

## THE VALUE OF BIOMASS NUTRIENT

### Key findings

- K rate response
- POLY multi-nutrient premium
- At 150 K<sub>2</sub>O ha<sup>-1</sup> MOP, POLY4 and partial substituted straw K have similar value
- Straw alone exhibits the familiar depression
  - N demand
  - Nutrient delivery rate

### China wheat yield response from potash sources



### KEY TAKEAWAY:

ALL NUTRIENT SOURCES SUPPLEMENT SOIL SUPPLY

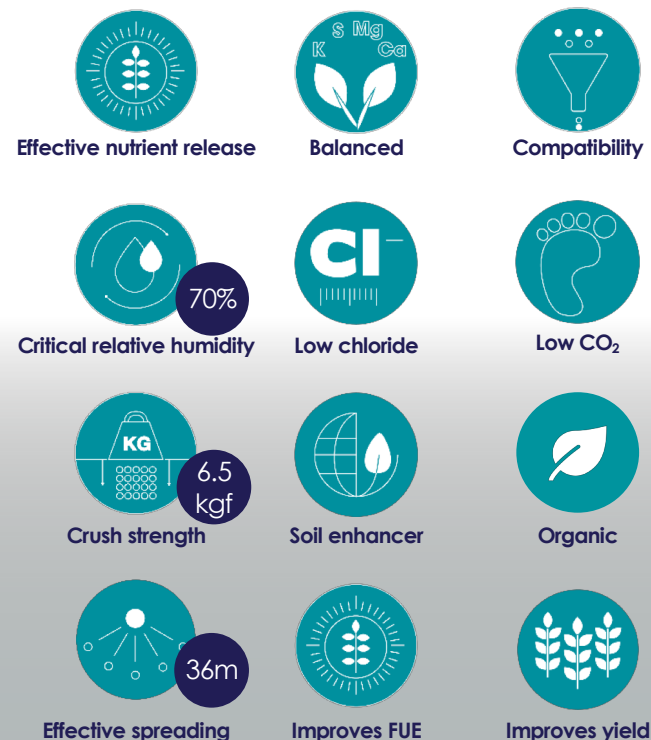
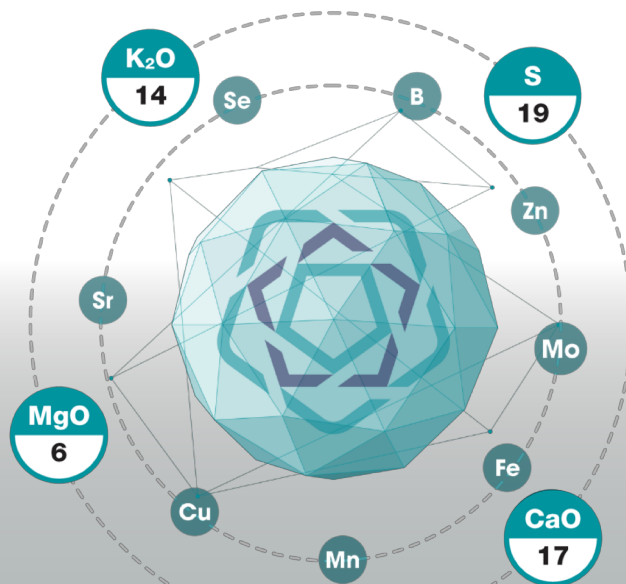


## INTRODUCING POLY4

A single source of bulk nutrients as foundation for effective, efficient, flexible and sustainable fertilization.

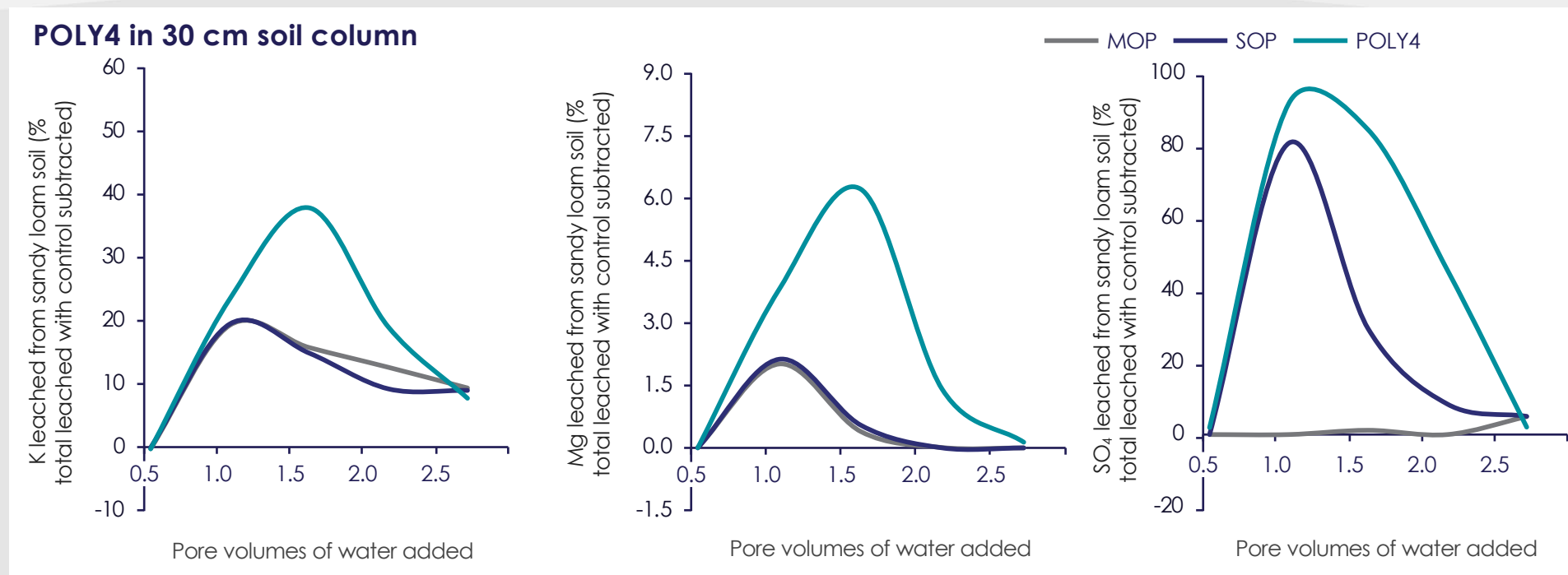
### Characteristics

- Improves yield and quality
- Straight or as part of a fertilizer blend
- Efficient nutrient release profile
- pH neutral



Notes: 1) Based on 90% polyhalite grade. Macro nutrients based on w/w % and micro nutrients based on mg/kg; micro nutrients' content: B 169, Zn 1.9, Mn 3.1, Mo 0.3, Se>0.5, Fe>0.5, Cu 1.1, Sr 1414. 2) POLY4 is the trademark name for polyhalite products from the Sirius Minerals polyhalite project in North Yorkshire. \*48% SO<sub>3</sub>. B – boron, Cu – copper, Se – selenium, Zn – zinc, Fe – iron, Sr – strontium, Mo – molybdenum, Mn – manganese.

## NUTRIENT DELIVERY TIMEFRAME WITH POLY4



### KEY TAKEAWAY:

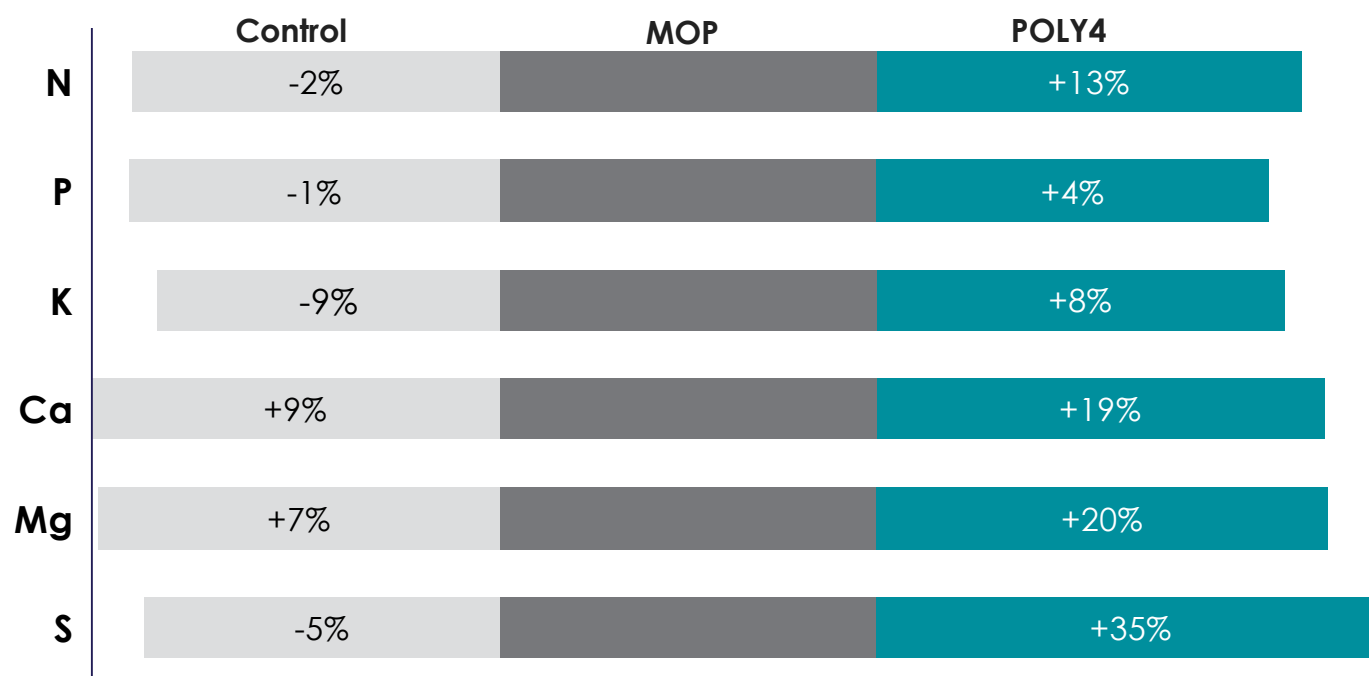
**POLY4 SUPPLIES NUTRIENTS AT CROP APPROPRIATE RATES**

Notes: 1) Amount of water is monthly equivalent to two years rainfall based on a five year average rainfall of 1385 mm yr<sup>-1</sup> in Florida; 2) Fertilizer application rate of 300 kg K<sub>2</sub>O ha<sup>-1</sup>. Soil analysis for pH 8.06, 44 mg K kg<sup>-1</sup>, 1360 mg Ca kg<sup>-1</sup>, 551 mg Mg kg<sup>-1</sup>, 15,642 mg S kg<sup>-1</sup>, OM 0.4%, soil texture: 88.4% sand, 0.6% silt, 10.6% clay.  
Source: University of Florida (2015) 1000-UOF-1024-14.

## EU: SUSTAINED MACRO-NUTRIENT DELIVERY

Macro-nutrient uptake results from EU trials<sup>1</sup>

### Improvements in macro-nutrient uptake compared to MOP



### Initial soil analysis<sup>1</sup>

Soil measurement	Value
P (mg kg <sup>-1</sup> )	56
K (mg kg <sup>-1</sup> )	113
Mg (mg kg <sup>-1</sup> )	98
Ca (mg kg <sup>-1</sup> )	2047
S (mg kg <sup>-1</sup> )	5
OM (g kg <sup>-1</sup> )	19

### KEY TAKEAWAY:

**POLY4 OUTPERFORMED MOP IN MACRO-NUTRIENT UPTAKE**

Notes: 1) The results are based on 11 EU trials covering both high-value and broad-acre crops such potato, wheat, barley, oilseed rape, silage corn, corn and celery.  
Source: Sirius Minerals



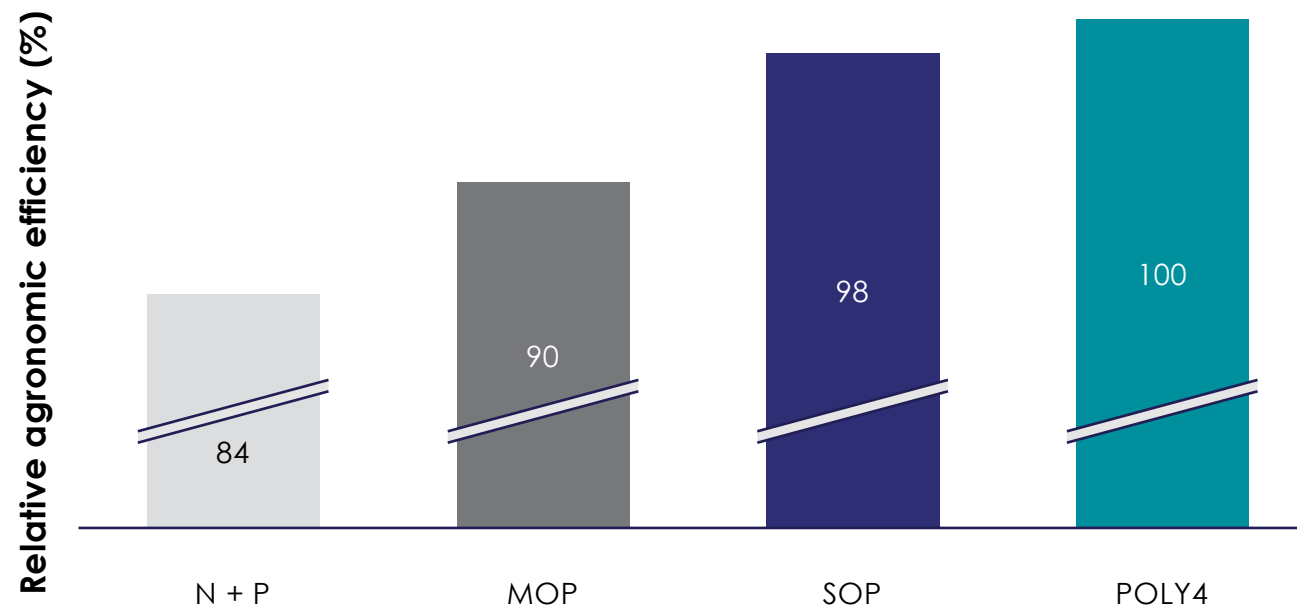
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## EU: POLY4 PERFORMANCE COMPARED TO POTASH SOURCES

Yield results from 23 straight EU trials

Average POLY4 performance against other K sources



Initial soil analysis

Soil measurement	Value
P (mg kg <sup>-1</sup> )	63
K (mg kg <sup>-1</sup> )	105
Mg (mg kg <sup>-1</sup> )	80
Ca (mg kg <sup>-1</sup> )	1630
S (mg kg <sup>-1</sup> )	4
OM (g kg <sup>-1</sup> )	15

**KEY TAKEAWAY:**

**POLY4 OUTPERFORMED MOP AND SOP**

Notes: Crops include: barley, oilseed rape, corn, potato, wheat and grass.  
Source: Sirius Minerals.

## CROP QUALITY

### Tomato quality

- Brix (sweetness) +1.6%
- Firmness, indicating shelf life +1.3%
- Titratable acidity (reduction in sharpness) -3.8%
- Tomato bacterial spot – 38% reduction in severity compared to MOP 72 days after planting



### Potato quality

- Specific gravity – 1.07, indicates dry matter content 20% which is important for frying quality
- Tuber brightness score 6.5 indicating tuber health and disease resistance



### Cereals

- Increased grain nutrients
- Lower N:S ratio in leaf
- NDVI rating
- Improved tiller numbers
- Reduced lodging



### Turf

- Higher NDVI
- Microgranule complete dispersal in under a month
- Improved longevity of turf quality
- Improved/better control of red thread disease

## WHAT IS THE BEST MEASURE OF FERTILIZER USE EFFICIENCY?

Common measures of NUE compared

Term	Calculation	Objective
Partial factor productivity	$PFP = Y/F$	How productive is this cropping system in comparison to its nutrient input – long-term trend indicator.
Agronomic efficiency	$AE = (Y - Y_0)/(F - F_0)$	Production gain from nutrients – short-term impact on yield.
Partial nutrient balance	$PNB = U_H/F$	Output compared to input – nutrient balance trends.
Apparent recovery efficiency	$RE = (U - U_0)/(F - F_0)$	How much of the applied is taken up – comparing management practices.
Internal utilization efficiency	$IE = Y/U$	Offtake compared to uptake – comparing genotypes.
Physiological efficiency	$PE = (Y - Y_0)/(U - U_0)$	Improvement in yield compared to improvement in nutrient uptake – compare practices.
Fertilizer use efficiency	$FUE = U/F$	Efficiency of nutrient capture – to compare systems.

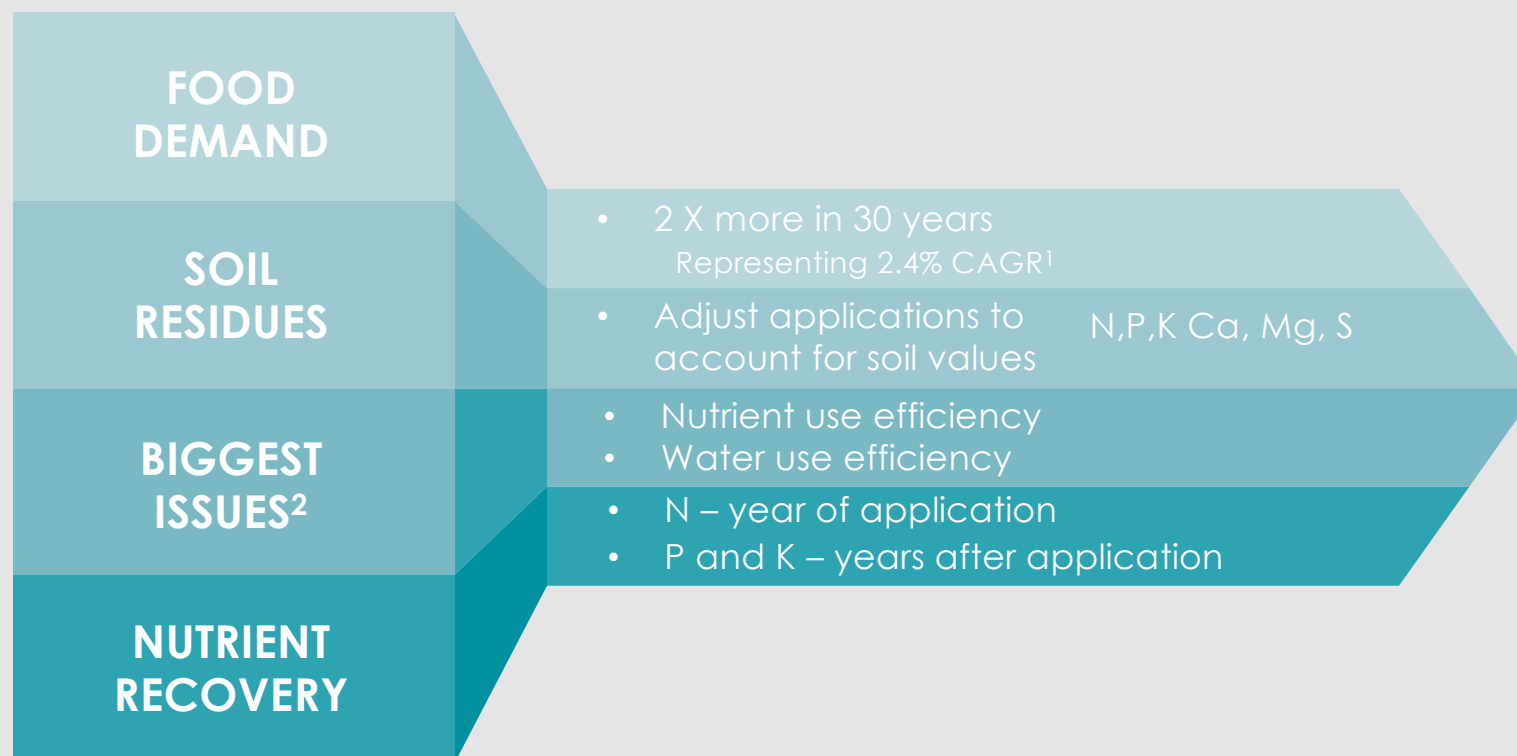
Y = yield,  $Y_0$  = yield without nutrient, F = fertilizer applied,  $U_H$  = Nutrient in harvested parts, U = nutrients in above ground biomass with nutrient applied,  $U_0$  = nutrient in above ground biomass with no nutrient applied.

### KEY TAKEAWAY:

**EFFICIENCY MEASUREMENTS ARE NOT COMPARABLE AND MAY NOT ACCOUNT FOR ALL ASPECTS, SI, EC, NUTRIENT BALANCE**

## THINK OUTSIDE THE BOX WHEN EVALUATING FERTILIZER

Providing economically optimum nourishment to the crop while minimizing nutrient losses from the field



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### KEY TAKEAWAY:

TOTAL SYSTEM NUTRIENT MASS BALANCE SHOULD BE CONSIDERED



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# THANK YOU

Any questions please contact:

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