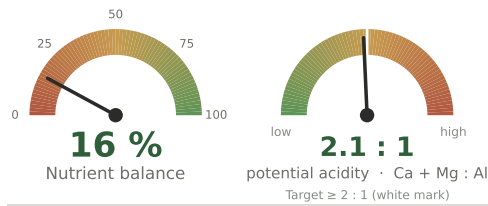


Soil Balancing + Haney soil vitality · overall evaluation

SOIL CHEMISTRY



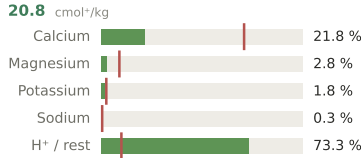
Soil type slightly loamy sand C/N 17.4 bulk density 1.39 g/cm³ · calculated
ENR (N release) $\approx$ 67 kg N/ha · estimated

Haney value
Target 6.0–6.5

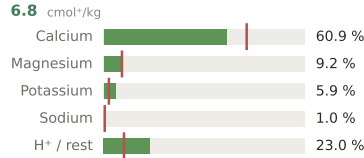
BASE SATURATION ON THE THREE EXCHANGERS

red mark = TARGET

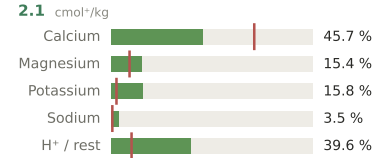
CEC pot (DIN)



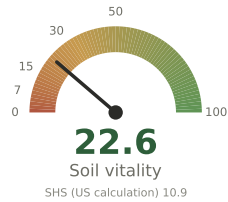
CEC act



CEC plant-available *



SOIL BIOLOGY



Organic matter **6.48 %**

microb. respiration (CO₂) **27.0 mg/kg**

Microbial food C **199 mg/kg**

Microbial food N **124 kg/ha**

microbially active C **13.6 %**

Haney value

microbially active C: above 80 % = humus-degrading environment · below 30 % = too little activity despite food supply

PLANT-AVAILABLE NITROGEN AND PHOSPHORUS OVER THE GROWING SEASON

plant-available nitrogen (N) **68** kg N/ha plant-available phosphate (P₂O₅) **149** kg P₂O₅/ha

Plant-available N and P over the growing season based on the biological and chemical parameters and the assumption of several rainfall events during the season.

The three most important measures

Problem	Measures	Note
pH and calcium/magnesium saturation too low	fertilise in the form of lime and sulphate	see fertiliser recommendation
too little active C	year-round green cover, use of biostimulants, liming, use of biochar, soil aeration ...	
microbial respiration too low	year-round green cover, use of biostimulants, organic fertilisation ...	

COVER CROP RECOMMENDATION



Microbial food C : N very narrow — focus on carbon supply

Methods & notes

* CEC plant-available = sum of Ca, Mg, K, Na and H⁺ from the H3A extraction (Haney); only the immediately available part of the exchanger, therefore clearly lower than CEC pot (DIN ISO 13536) and CEC act. Potential acidity: derived from (Ca + Mg) : Al of the H3A extraction. Nutrient balance: weighted deviation from the optimum (pH, CEC difference, base saturation, nutrient targets), before fertilisation. pH values and organic matter from the Haney analysis; base saturation target (CEC pot-dependent) on all three exchangers.

Nutrient contents · ratios · interactions

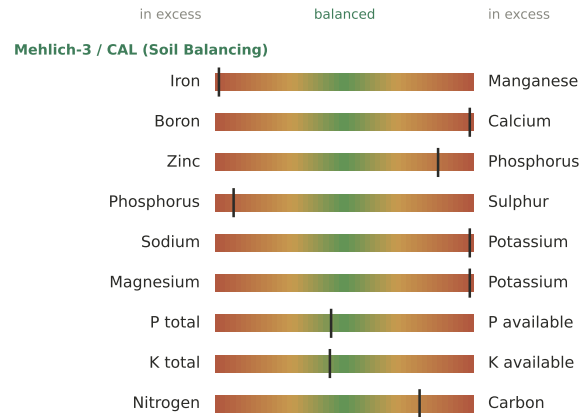
NUTRIENT CONTENTS — TWO FRACTIONS

per nutrient: plant-available (Haney H3A) and reserve/exchangeable (Mehlich-3), kg/ha

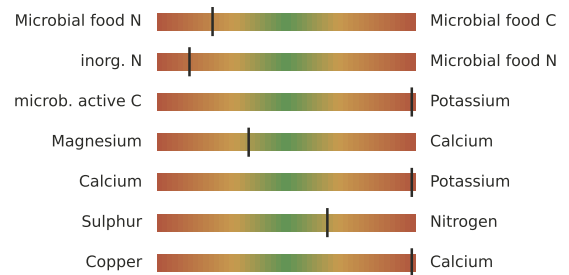
	plant-available (H3A)				reserve (Mehlich-3)		
	ACTUAL	TARGET			ACTUAL	TARGET	
Calcium	559	831		2,291	8,219		
Magnesium	113	88.0		209	625		
Potassium	377	95.3		436	564		
Sodium	49.2	–		41.7	59.1		
Phosphorus (PO ₄ / M3)	191	58.2		523	179		
reserve org. P	69.0	29.1		–			
Sulphur	84.4	88.2		75.1	139		
Boron	0.441	3.65		0.445	3.96		
Copper	0.412	0.300		1.39	18.1		
Manganese	5.09	14.7		33.4	209		
Iron	1,504	88.2		2,349	723		
Zinc	15.3	13.0		30.3	27.8		
Molybdenum	0.056	0.500		b. d. l.	1.58		
Cobalt	0.032	4.00		1.67	8.09		
Selenium	–			0.862	3.61		

‡ Cobalt/selenium from total digestion. ACTUAL and TARGET in kg/ha; marker = position of ACTUAL relative to TARGET (centre = TARGET reached).

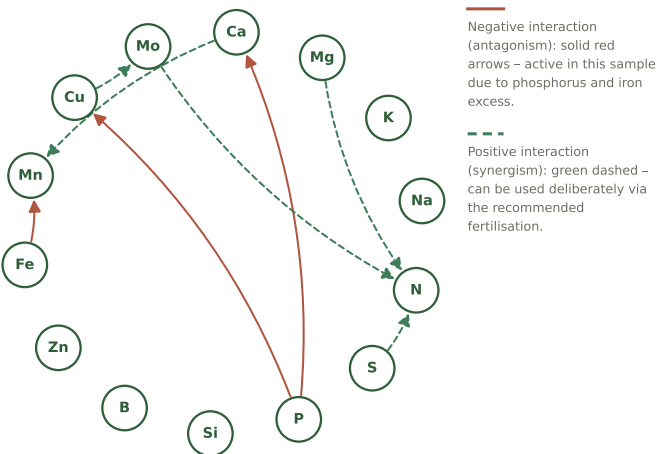
NUTRIENT RATIOS



H3A / soil biology (Haney)



NUTRIENT INTERACTIONS (MULDER)



Only the negative interactions present in this sample and the synergisms that can be used for balancing are shown.

LUFA STANDARD ANALYSIS · CONTENT CLASSES

Netherlands · content classes according to the Bavarian scheme

Phosphorus (P ₂ O ₅ , CAL)	38.7 mg/100 g	Cl. E
Potassium (K ₂ O, CAL)	16.8 mg/100 g	Cl. D
Magnesium (CaCl ₂)	7.4 mg/100 g	Cl. C

Fertiliser recommendation

Fertiliser	Quantity	Covers	Period	Application / note
Dolomite 60 % CaCO ₃ · 25 % MgCO ₃	4,000 kg/ha	Calcium + magnesium (building up base saturation)	spread over 3–4 years	Basic fertilisation (Ca + Mg); continue maintenance liming according to carbonate test. Do not mix with trace elements– apply at separate times.
Sodium molybdate 39 % Mo	5.5 kg/ha	Molybdenum	spread over 3–4 years	Apply before the sulphate fertilisers (Mo availability decreases with sulphate S). Foliar application; can be mixed into slurry.
Calcium sulphate (gypsum) 33 % CaO · 46 % SO ₃	550 kg/ha	Sulphate sulphur + calcium	spread over 3–4 years	Supplies Ca and sulphate sulphur without raising pH; spread in spring. Do not combine with water-soluble P (fixation).
Kieserite 25 % MgO · 50 % SO ₃	300 kg/ha	Magnesium (+ sulphate sulphur)	spread over 3–4 years	Readily water-soluble; spread in spring into the growing crop or the cover crop, split into several applications over the years. Also covers the sulphate share of the sulphur.
Magnesia kainite 9 % K ₂ O · 4 % MgO · 36 % Na ₂ O · 8 % SO ₃	80 kg/ha	Potassium + magnesium + sodium (+ sulphate S)	1–2 years	Covers K, Mg and Na together; spread. Note the chloride– not shortly before chloride-sensitive crops.
Potassium sulphate 50 % K ₂ O · 45 % SO ₃	180 kg/ha	Potassium	2–3 years	Low K requirement – can be covered in one application. Spread in spring into the growing crop.
Boric acid 17.4 % B	30 kg/ha	Boron	spread over 3–4 years	Cannot be applied in advance; foliar application, repeat annually as required.
Copper sulphate 23 % Cu	29 kg/ha	Copper	spread over 3–4 years	Not together with lime/calcium – apply at separate times; more effective with humic acids.
Manganese sulphate 30 % Mn	50 kg/ha	Manganese	spread over 3–4 years	Foliar application, do not mix with lime/calcium, more effective with humic acids.
Sodium selenate 39 % Se	2 kg/ha	Selenium	spread over 3–4 years	For feed and animal health; apply as a foliar dressing.

NOTES ON IMPLEMENTATION

Application – cover crop, clover/lucerne grass or high-uptake main crop: The recommended fertiliser quantities may in some cases be very high. Application causes a temporary imbalance to which the soil biology first has to adjust. Preferably apply in cover crops or clover/lucerne grass stands – there the nutrients are dynamised and are available to the following crop in the right ratio. Alternatively, the fertilisers can also be applied directly to main crops with a good uptake capacity for the respective nutrient – there up to a maximum of twice the crop requirement per application. High-uptake crops:

Sulphates (S): Oilseed rape, brassica and allium vegetables, grain legumes, grassland
Calcium: Oilseed rape, potatoes, brassicas, clover/lucerne grass, grassland
Magnesium: Potatoes, beet, maize, clover/lucerne grass
Potassium: Beet, potatoes, maize, brassicas, clover/lucerne grass
Sodium: Sugar/fodder beet (sodium-loving), fodder kale
Phosphorus: Potatoes, maize, clover/lucerne grass, grassland
Boron: Oilseed rape, sugar/fodder beet, sunflowers, brassicas, lucerne

Molybdenum: Grain legumes, clover/lucerne grass, brassicas, oilseed rape
Cobalt: Grain legumes (field bean, soya, lupin, pea), clover/lucerne grass
Copper: Oats, wheat, barley, sunflowers, grassland
Zinc: Maize, flax, hops, fruit growing
Manganese: Oats, wheat, sugar/fodder beet, peas/field beans
Selenium: Grassland (forage quality)

Organic fertilisation: Carrier materials (rock dust / biochar) should be mixed into organic fertilisers to prevent leaching and to avoid overloading the exchanger with nutrients.

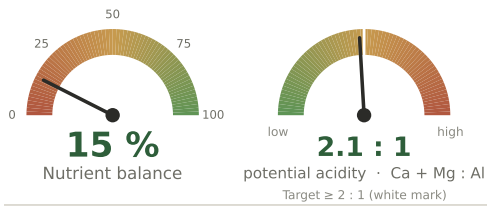
Trace elements: Do not apply zinc (or copper, manganese, iron, cobalt) together with lime/calcium – apply at separate times. For application they can also be mixed together into slurry/compost (instead of foliar application).

Systemic approach: The method only achieves the desired success in combination with consistent cover cropping, undersowing and mixed cropping.

The calculated fertiliser quantities are guide values for closing the identified nutrient gap; compliance with the applicable fertiliser legislation (e.g. fertiliser ordinance, closed periods, farm-level limits) is the responsibility of the farm. The values and recommendations shown do not replace individual professional advice and are not legally binding.

Soil Balancing + Haney soil vitality · overall evaluation

SOIL CHEMISTRY



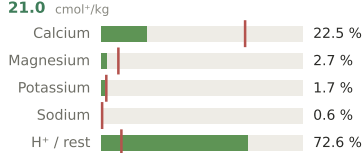
Soil type slightly loamy sand C/N 16.8 bulk density 1.39 g/cm³ · calculated
ENR (N release) $\approx$ 74 kg N/ha · estimated

Target 6.0–6.5

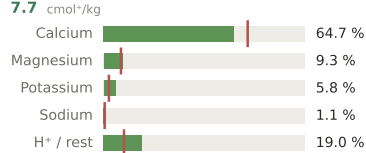
BASE SATURATION ON THE THREE EXCHANGERS

red mark = TARGET

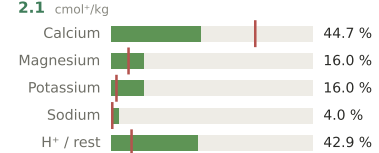
CEC pot (DIN)



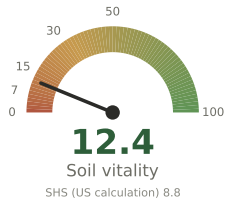
CEC act



CEC plant-available *



SOIL BIOLOGY



Organic matter **6.54 %**

microb. respiration (CO₂) **24.0 mg/kg**

Microbial food C **166 mg/kg**

Microbial food N **91.2 kg/ha**

microbially active C **14.4 %**

microbially active C: above 80 % = humus-degrading environment · below 30 % = too little activity despite food supply

PLANT-AVAILABLE NITROGEN AND PHOSPHORUS OVER THE GROWING SEASON

plant-available nitrogen (N) **62** kg N/ha plant-available phosphate (P₂O₅) **157** kg P₂O₅/ha

Plant-available N and P over the growing season based on the biological and chemical parameters and the assumption of several rainfall events during the season.

The three most important measures

Problem	Measures	Note
pH and calcium/magnesium saturation too low	fertilise in the form of lime and sulphate	see fertiliser recommendation
microbial respiration too low	year-round green cover, use of biostimulants, organic fertilisation ...	
too little active C	year-round green cover, use of biostimulants, liming, use of biochar, soil aeration ...	

COVER CROP RECOMMENDATION



Microbial food C : N very narrow — focus on carbon supply

Methods & notes

* CEC plant-available = sum of Ca, Mg, K, Na and H⁺ from the H3A extraction (Haney); only the immediately available part of the exchanger, therefore clearly lower than CEC pot (DIN ISO 13536) and CEC act. Potential acidity: derived from (Ca + Mg) : Al of the H3A extraction. Nutrient balance: weighted deviation from the optimum (pH, CEC difference, base saturation, nutrient targets), before fertilisation. pH values and organic matter from the Haney analysis; base saturation target (CEC pot-dependent) on all three exchangers.

Nutrient contents · ratios · interactions

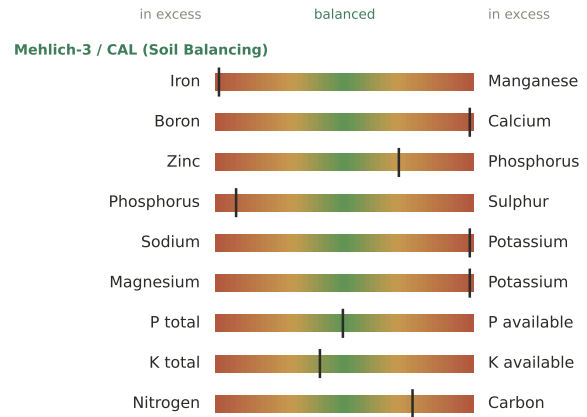
NUTRIENT CONTENTS — TWO FRACTIONS

per nutrient: plant-available (Haney H3A) and reserve/exchangeable (Mehlich-3), kg/ha

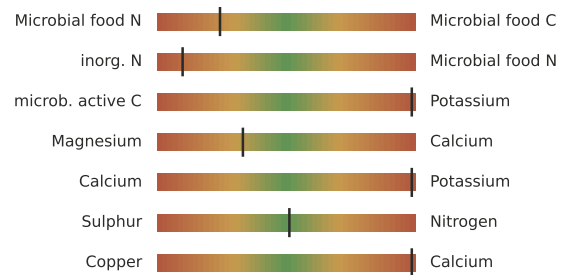
	plant-available (H3A)				reserve (Mehlich-3)		
	ACTUAL	TARGET			ACTUAL	TARGET	
Calcium	547	831		2,774	8,352		
Magnesium	118	88.0		239	596		
Potassium	382	95.4		487	569		
Sodium	55.8	–		55.6	55.9		
Phosphorus (PO ₄ / M3)	201	58.2		478	179		
reserve org. P	65.5	29.1		–			
Sulphur	89.6	88.2		77.8	139		
Boron	0.470	3.63		0.473	4.44		
Copper	0.412	0.300		1.39	18.1		
Manganese	5.14	14.7		36.1	209		
Iron	1,642	88.2		2,388	723		
Zinc	15.8	13.3		33.6	27.8		
Molybdenum	0.103	0.500		b. d. l.	1.61		
Cobalt	0.015	4.00		1.95	8.56		
Selenium	–			1.03	3.61		

‡ Cobalt/selenium from total digestion. ACTUAL and TARGET in kg/ha; marker = position of ACTUAL relative to TARGET (centre = TARGET reached).

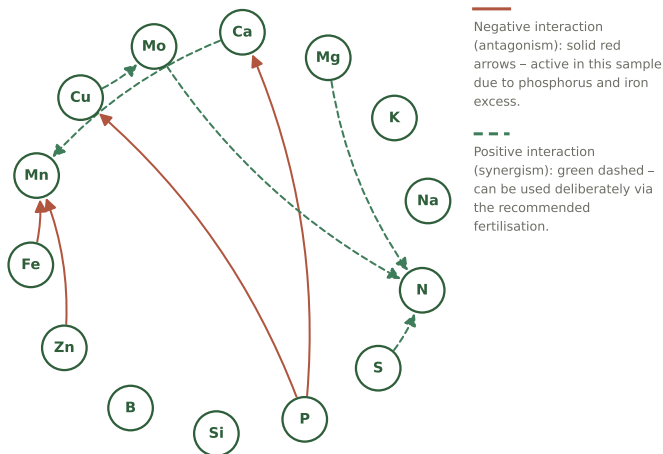
NUTRIENT RATIOS



H3A / soil biology (Haney)



NUTRIENT INTERACTIONS (MULDER)



Only the negative interactions present in this sample and the synergisms that can be used for balancing are shown.

LUFA STANDARD ANALYSIS · CONTENT CLASSES

Netherlands · content classes according to the Bavarian scheme

Phosphorus (P ₂ O ₅ , CAL)	39.0 mg/100 g	Cl. E
Potassium (K ₂ O, CAL)	17.1 mg/100 g	Cl. D
Magnesium (CaCl ₂)	8.1 mg/100 g	Cl. C

Fertiliser recommendation

Fertiliser	Quantity	Covers	Period	Application / note
Dolomite 60 % CaCO ₃ · 25 % MgCO ₃	4,000 kg/ha	Calcium + magnesium (building up base saturation)	spread over 3–4 years	Basic fertilisation (Ca + Mg); continue maintenance liming according to carbonate test. Do not mix with trace elements – apply at separate times.
Sodium molybdate 39 % Mo	5.5 kg/ha	Molybdenum	spread over 3–4 years	Apply before the sulphate fertilisers (Mo availability decreases with sulphate S). Foliar application; can be mixed into slurry.
Calcium sulphate (gypsum) 33 % CaO · 46 % SO ₃	550 kg/ha	Sulphate sulphur + calcium	spread over 3–4 years	Supplies Ca and sulphate sulphur without raising pH; spread in spring. Do not combine with water-soluble P (fixation).
Kieserite 25 % MgO · 50 % SO ₃	180 kg/ha	Magnesium (+ sulphate sulphur)	2–3 years	Readily water-soluble; spread in spring into the growing crop or the cover crop, split into several applications over the years. Also covers the sulphate share of the sulphur.
Patentkali (SOP-Mg) 30 % K ₂ O · 10 % MgO · 44 % SO ₃	330 kg/ha	Potassium + magnesium (+ sulphate S)	spread over 3–4 years	Covers K and Mg (low in chloride); spread in spring.
Boric acid 17.4 % B	30 kg/ha	Boron	spread over 3–4 years	Cannot be applied in advance; foliar application, repeat annually as required.
Copper sulphate 23 % Cu	29 kg/ha	Copper	spread over 3–4 years	Not together with lime/calcium – apply at separate times; more effective with humic acids.
Manganese sulphate 30 % Mn	50 kg/ha	Manganese	spread over 3–4 years	Foliar application, do not mix with lime/calcium, more effective with humic acids.
Sodium selenate 39 % Se	2 kg/ha	Selenium	spread over 3–4 years	For feed and animal health; apply as a foliar dressing.

NOTES ON IMPLEMENTATION

Application – cover crop, clover/lucerne grass or high-uptake main crop: The recommended fertiliser quantities may in some cases be very high. Application causes a temporary imbalance to which the soil biology first has to adjust. Preferably apply in cover crops or clover/lucerne grass stands – there the nutrients are dynamised and are available to the following crop in the right ratio. Alternatively, the fertilisers can also be applied directly to main crops with a good uptake capacity for the respective nutrient – there up to a maximum of twice the crop requirement per application. High-uptake crops:

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Calcium: Oilseed rape, potatoes, brassicas, clover/lucerne grass, grassland

Magnesium: Potatoes, beet, maize, clover/lucerne grass

Potassium: Beet, potatoes, maize, brassicas, clover/lucerne grass

Sodium: Sugar/fodder beet (sodium-loving), fodder kale

Phosphorus: Potatoes, maize, clover/lucerne grass, grassland

Boron: Oilseed rape, sugar/fodder beet, sunflowers, brassicas, lucerne

Molybdenum: Grain legumes, clover/lucerne grass, brassicas, oilseed rape

Cobalt: Grain legumes (field bean, soya, lupin, pea), clover/lucerne grass

Copper: Oats, wheat, barley, sunflowers, grassland

Zinc: Maize, flax, hops, fruit growing

Manganese: Oats, wheat, sugar/fodder beet, peas/field beans

Selenium: Grassland (forage quality)

Organic fertilisation: Carrier materials (rock dust / biochar) should be mixed into organic fertilisers to prevent leaching and to avoid overloading the exchanger with nutrients.

Trace elements: Do not apply zinc (or copper, manganese, iron, cobalt) together with lime/calcium – apply at separate times. For application they can also be mixed together into slurry/compost (instead of foliar application).

Systemic approach: The method only achieves the desired success in combination with consistent cover cropping, undersowing and mixed cropping.

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Soil Balancing + Haney soil vitality · field comparison

Example field B Example field A

Bar up to the red centre line = TARGET reached;
shorter = deficit, longer = excess (scale up to 2 × TARGET)

BASIC SOIL DATA — DEVIATION FROM TARGET

pH (CaCl ₂) · target 6.0–6.5	Example field B	–1.5	
	Example field A	–1.2	
pH (H ₂ O) · target 6.0–6.5	Example field B	–0.8	
	Example field A	–0.5	
C/N · target ~11	Example field B	+6.4	
	Example field A	+5.8	
Ca + Mg : Al · target ≥ 2 : 1	Example field B	+0.1	
	Example field A	+0.1	
Nutrient balance % · target 100	Example field B	–84	
	Example field A	–85	

BASE SATURATION (CEC POT) · % — DEV. FROM TARGET

Calcium	Example field B	–49.2	
	Example field A	–49.0	
Magnesium	Example field B	–6.2	
	Example field A	–5.8	
Potassium	Example field B	–0.7	
	Example field A	–0.8	
Sodium	Example field B	–0.2	
	Example field A	+0.2	

SOIL BIOLOGY (HANEY)

Soil vitality	Example field B	22.6	
	Example field A	12.4	
SHS (US calculation)	Example field B	10.9	
	Example field A	8.8	
microbial respiration CO ₂ -C mg/kg	Example field B	27	
	Example field A	24	
Microbial food C ppm	Example field B	199	
	Example field A	166	
water-extr. N (WEN) ppm	Example field B	75.6	
	Example field A	62.4	
microbially active C %	Example field B	13.6	
	Example field A	14.4	
Acidity index	Example field B	49	
	Example field A	48	

FURTHER INDICATORS (WITHOUT TARGET)

Humus %	Example field B	5.4	
	Example field A	5.8	
H ⁺ / rest %	Example field B	73.3	
	Example field A	72.6	
CEC pot cmol ⁺ /kg	Example field B	20.8	
	Example field A	21.0	
CEC act cmol ⁺ /kg	Example field B	6.8	
	Example field A	7.7	
CEC plant-available cmol ⁺ /kg	Example field B	2.1	
	Example field A	2.1	
Bulk density g/cm ³	Example field B	1.39	
	Example field A	1.39	
ENR kg N/ha	Example field B	67	
	Example field A	74	
P ₂ O ₅ (CAL) mg/100 g	Example field B	38.7	
	Example field A	39.0	
K ₂ O (CAL) mg/100 g	Example field B	16.8	
	Example field A	17.1	
Mg (CaCl ₂) mg/100 g	Example field B	7.4	
	Example field A	8.1	

Bar length relative to the larger of the two values.

NUTRIENT CONTENTS · kg/ha — DEV. FROM TARGET

Sulphur	Example field B	–63.9	
	Example field A	–61.2	
Phosphorus	Example field B	+344	
	Example field A	+300	
Calcium	Example field B	–5,928	
	Example field A	–5,578	
Magnesium	Example field B	–417	
	Example field A	–357	
Potassium	Example field B	–128	
	Example field A	–83	
Sodium	Example field B	–17.4	
	Example field A	–0.3	
Boron	Example field B	–3.5	
	Example field A	–4.0	
Iron	Example field B	+1,626	
	Example field A	+1,665	
Manganese	Example field B	–175.1	
	Example field A	–172.4	
Copper	Example field B	–16.7	
	Example field A	–16.7	
Zinc	Example field B	+2.5	
	Example field A	+5.8	
Molybdenum	Example field B	–1.5	
	Example field A	–1.5	
Cobalt	Example field B	–6.4	
	Example field A	–6.6	
Selenium	Example field B	–2.8	
	Example field A	–2.6	

FERTILISER RECOMMENDATION · kg/ha

Dolomite	Example field B	4,000	
	Example field A	4,000	
Sodium molybdate	Example field B	6	
	Example field A	6	
Calcium sulphate (gypsum)	Example field B	550	
	Example field A	550	
Kieserite	Example field B	300	
	Example field A	180	
Magnesia kainite	Example field B	80	
	Example field A	0	
Potassium sulphate	Example field B	180	
	Example field A	0	
Boric acid	Example field B	30	
	Example field A	30	
Copper sulphate	Example field B	29	
	Example field A	29	
Manganese sulphate	Example field B	50	
	Example field A	50	
Sodium selenate	Example field B	2	
	Example field A	2	
Patentkali (SOP-Mg)	Example field B	0	
	Example field A	330	

Bar length relative to the larger of the two quantities (no target reference).