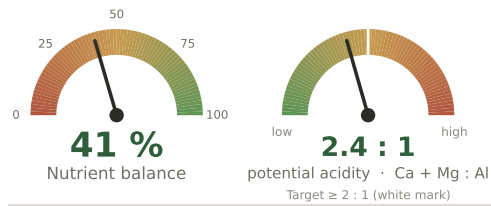


Soil Balancing + Haney soil vitality · overall evaluation

SOIL CHEMISTRY



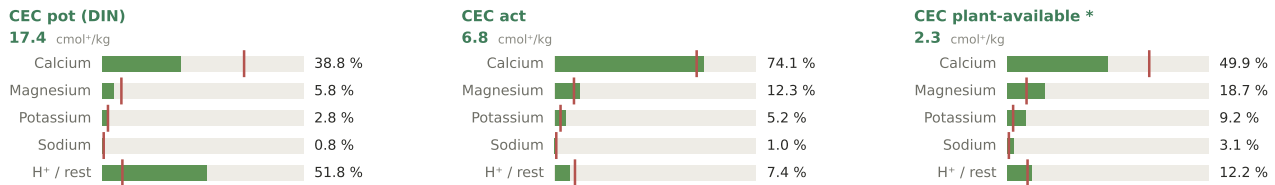
pH (H₂O) **6.29** Haney value

pH (CaCl₂) **5.58** Target 6.0–6.5

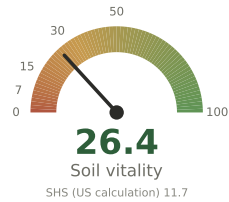
Soil type slightly loamy sand C/N 11.1 bulk density 1.55 g/cm³ · calculated
ENR (N release) $\approx$ 68 kg N/ha · estimated

BASE SATURATION ON THE THREE EXCHANGERS

red mark = TARGET



SOIL BIOLOGY



Organic matter **2.68 %** Haney value

microb. respiration (CO₂) **47.0 mg/kg**

Microbial food C **222 mg/kg**

Microbial food N **93.1 kg/ha**

microbially active C **21.2 %**

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) **20** kg N/ha plant-available phosphate (P₂O₅) **167** 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
Sulphur deficiency	Apply elemental sulphur and sulphate fertilisers	see fertiliser recommendation
too little active C	year-round green cover, use of biostimulants, liming, use of biochar, soil aeration ...	
Calcium-boron ratio too wide	Apply boron	see fertiliser recommendation

COVER CROP RECOMMENDATION



Microbial food C : N within target range — mixture graded by soil vitality

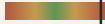
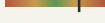
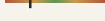
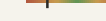
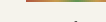
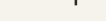
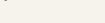
Methods & notes

* 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	827	1,126		3,891	9,496		
Magnesium	185	119		388	768		
Potassium	298	129		535	742		
Sodium	59.5	-		62.0	109		
Phosphorus (PO ₄ / M3)	267	72.8		1,213	204		
reserve org. P	112	36.4		-			
Sulphur	35.7	110		34.9	136		
Boron	0.735	4.73		1.12	3.89		
Copper	0.441	0.300		7.36	18.6		
Manganese	9.15	18.4		120	291		
Iron	577	110		2,298	853		
Zinc	15.9	19.0		38.0	38.8		
Molybdenum	0.099	0.500		n. a.	1.51	not analysed	
Cobalt	0.037	4.00		6.35	9.69		
Selenium	-			15.5	3.68		

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

AVAILABLE SHARE OF TOTAL CONTENT (TOTAL DIGESTION)

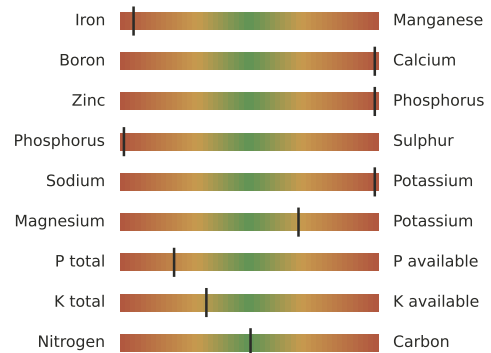
plant-available fraction (H3A) in % of total content · grey: available / total in mg/kg · green = within target range, red = outside

● Calcium	13.6 % 225 / 1,650	(> 8)	● Magnesium	4.9 % 50.4 / 1,030	(> 5)
● Potassium	4.5 % 81.1 / 1,800	(> 3)	● Sodium	9.5 % 16.2 / 170	(> 3)
● Phosphorus (PO ₄)	7.3 % 72.7 / 1,000	(> 5)	● reserve org. P	3.1 % 30.6 / 1,000	(> 5)
● Sulphur	2.4 % 9.7 / 400	(> 15)	● Boron	2.6 % 0.20 / 7.7	(> 8)
● Copper	1.3 % 0.12 / 9.3	(> 3)	● Manganese	1.0 % 2.5 / 261	(1–3)
● Iron	1.7 % 157 / 9,340	(1–3)	● Zinc	12.6 % 4.3 / 34.5	(–)
● Aluminium	1.3 % 117 / 9,069	(< 0.5)	● Microbial food C	1.4 % 222 / 15,600	(2–4)
● Microbial food N	2.1 % 25.3 / 1,200	(3–5)	● Nitrate-N	0.1 % 1.7 / 1,200	(< 0.3)
● Ammonium-N	0.2 % 2.1 / 1,200	(< 0.5)			

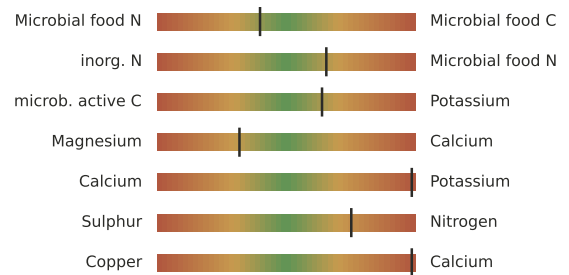
NUTRIENT RATIOS

in excess balanced in excess

Mehlich-3 / CAL (Soil Balancing)



H3A / soil biology (Haney)

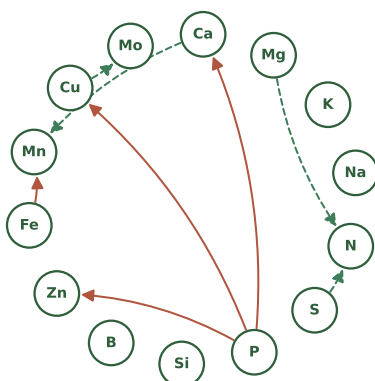


LUFA STANDARD ANALYSIS · CONTENT CLASSES

North Rhine-Westphalia · LUFA method assigned by postcode

Phosphorus (P ₂ O ₅ , CAL)	30.0 mg/100 g	Cl. D
Potassium (K, CAL)	9.2 mg/100 g	Cl. C
Magnesium (CaCl ₂)	8.2 mg/100 g	Cl. E

NUTRIENT INTERACTIONS (MULDER)



Negative interaction (antagonism): solid red arrows – active in this sample due to phosphorus and iron excess.

Positive interaction (synergism): green dashed – can be used deliberately via the recommended fertilisation.

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

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.
Elemental sulphur 90 % S	40 kg/ha	Sulphur (5 % of requirement)	over 1–2 years	Slow-acting → apply first and ideally half a year before the other nutrients; the remaining sulphur is covered by the sulphate fertilisers.
Calcium sulphate (gypsum) 33 % CaO · 46 % SO ₃	520 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	270 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.
Boric acid 17.4 % B	23 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.

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)

Elemental sulphur with boron: Additional application of elemental sulphur with boron (e.g. 30 kg/ha Wigor S&B) at sowing of the main crops is advisable.

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

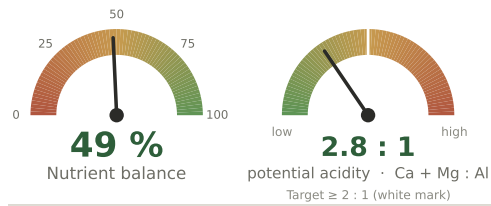
Trace elements: Do not apply zinc (or copper, manganese, iron, cobalt) together with lime/calcium – apply at separate times. For application they can also be mixed together into slurry/compost (instead of foliar application).

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



pH (H₂O) **6.28** | Haney value

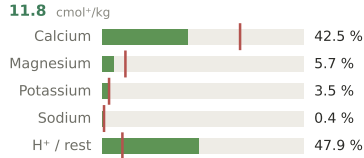
pH (CaCl₂) **5.62** | Target 6.0–6.5

Soil type slightly loamy sand C/N 8.5 bulk density 1.60 g/cm³ · calculated
ENR (N release) $\approx$ 68 kg N/ha · estimated

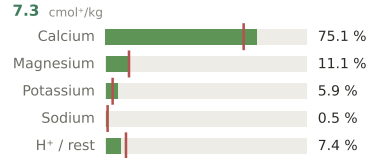
BASE SATURATION ON THE THREE EXCHANGERS

red mark = TARGET

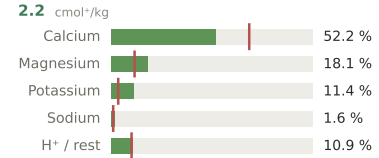
CEC pot (DIN)



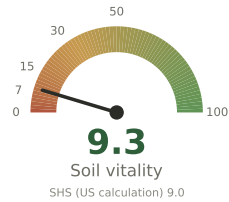
CEC act



CEC plant-available *



SOIL BIOLOGY



Organic matter **2.43 %** | Haney value

microb. respiration (CO₂) **32.0 mg/kg** |

Microbial food C **222 mg/kg** |

Microbial food N **47.9 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) **15** kg N/ha plant-available phosphate (P₂O₅) **170** 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
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 ...	
Sulphur deficiency	Apply elemental sulphur and sulphate fertilisers	see fertiliser recommendation

COVER CROP RECOMMENDATION



Microbial food C : N within target range — mixture graded by soil vitality

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	856	1,116		4,364	6,466		
Magnesium	178	118		388	651		
Potassium	364	128		664	620		
Sodium	30.1	-		32.0	94.3		
Phosphorus (PO ₄ / M3)	272	72.8		1,300	189		
reserve org. P	112	36.4		-			
Sulphur	29.0	110		32.0	120		
Boron	0.808	4.77		1.24	4.36		
Copper	0.404	0.300		9.20	14.0		
Manganese	7.97	18.4		124	300		
Iron	499	110		2,360	760		
Zinc	15.3	19.2		39.2	40.0		
Molybdenum	0.066	0.500		n. a.	1.52	not analysed	
Cobalt	0.037	4.00		6.53	10.0		
Selenium	-			16.2	3.60		

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

AVAILABLE SHARE OF TOTAL CONTENT (TOTAL DIGESTION)

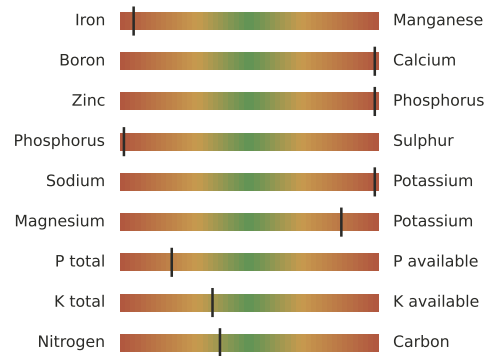
plant-available fraction (H3A) in % of total content · grey: available / total in mg/kg · green = within target range, red = outside

● Calcium	12.9 % 233 / 1,800	(> 8)	● Magnesium	4.6 % 48.4 / 1,050	(> 5)
● Potassium	5.5 % 99.0 / 1,800	(> 3)	● Sodium	5.1 % 8.2 / 160	(> 3)
● Phosphorus (PO ₄)	7.4 % 74.0 / 1,000	(> 5)	● reserve org. P	3.0 % 30.5 / 1,000	(> 5)
● Sulphur	3.9 % 7.9 / 200	(> 15)	● Boron	2.8 % 0.22 / 8.0	(> 8)
● Copper	1.1 % 0.11 / 9.8	(> 3)	● Manganese	0.9 % 2.2 / 255	(1–3)
● Iron	1.4 % 136 / 9,484	(1–3)	● Zinc	12.0 % 4.2 / 34.8	(–)
● Aluminium	1.1 % 102 / 9,169	(< 0.5)	● Microbial food C	1.6 % 222 / 14,200	(2–4)
● Microbial food N	1.1 % 13.0 / 1,200	(3–5)	● Nitrate-N	0.3 % 4.0 / 1,200	(< 0.3)
● Ammonium-N	0.2 % 2.2 / 1,200	(< 0.5)			

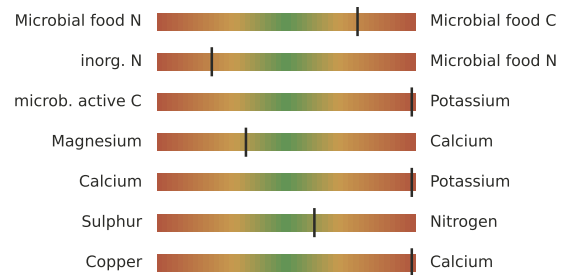
NUTRIENT RATIOS

in excess balanced in excess

Mehlich-3 / CAL (Soil Balancing)



H3A / soil biology (Haney)

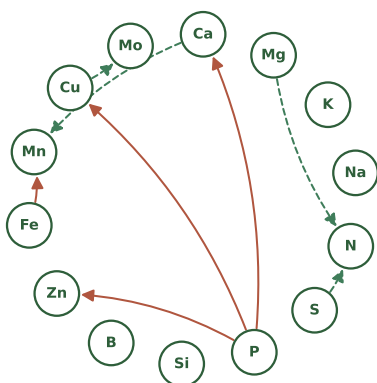


LUFA STANDARD ANALYSIS · CONTENT CLASSES

North Rhine-Westphalia · LUFA method assigned by postcode

Phosphorus (P ₂ O ₅ , CAL)	29.8 mg/100 g	Cl. D
Potassium (K, CAL)	11.9 mg/100 g	Cl. C
Magnesium (CaCl ₂)	7.7 mg/100 g	Cl. E

NUTRIENT INTERACTIONS (MULDER)



Negative interaction (antagonism): solid red arrows – active in this sample due to phosphorus and iron excess.

Positive interaction (synergism): green dashed – can be used deliberately via the recommended fertilisation.

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

Fertiliser recommendation

Fertiliser	Quantity	Covers	Period	Application / note
Dolomite 60 % CaCO ₃ · 25 % MgCO ₃	2,260 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.
Calcium sulphate (gypsum) 33 % CaO · 46 % SO ₃	330 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	220 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.
Boric acid 17.4 % B	12 kg/ha	Boron	2–3 years	Cannot be applied in advance; foliar application, repeat annually as required.
Copper sulphate 23 % Cu	19 kg/ha	Copper	2–3 years	Not together with lime/calcium – apply at separate times; more effective with humic acids.
Rock salt 95 % NaCl	47 kg/ha	Sodium	2–3 years	Foliar application or mixed into slurry; do not mix with lime/calcium.
Manganese sulphate 30 % Mn	32 kg/ha	Manganese	spread over 3–4 years	Foliar application, do not mix with lime/calcium, more effective with humic acids.

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 · field comparison

■ Example field A ■ Example field B

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 A ■ Example field B	–0.5 –0.5	
pH (H ₂ O) · target 6.0–6.5	■ Example field A ■ Example field B	+0.2 +0.2	
C/N · target ~11	■ Example field A ■ Example field B	+0.1 –2.5	
Ca + Mg : Al · target ≥ 2 : 1	■ Example field A ■ Example field B	+0.4 +0.8	
Nutrient balance % · target 100	■ Example field A ■ Example field B	–59 –51	

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

Calcium	■ Example field A ■ Example field B	–31.7 –26.0	
Magnesium	■ Example field A ■ Example field B	–3.7 –5.8	
Potassium	■ Example field A ■ Example field B	–0.0 +0.1	
Sodium	■ Example field A ■ Example field B	+0.1 –0.4	

SOIL BIOLOGY (HANEY)

Soil vitality	■ Example field A ■ Example field B	26.4 9.3	
SHS (US calculation)	■ Example field A ■ Example field B	11.7 9.0	
microbial respiration CO ₂ -C mg/kg	■ Example field A ■ Example field B	47 32	
Microbial food C ppm	■ Example field A ■ Example field B	222 222	
water-extr. N (WEN) ppm	■ Example field A ■ Example field B	29.2 19.2	
microbially active C %	■ Example field A ■ Example field B	21.2 14.4	
Acidity index	■ Example field A ■ Example field B	41 31	

FURTHER INDICATORS (WITHOUT TARGET)

Humus %	■ Example field A ■ Example field B	2.1 1.9	
H ⁺ / rest %	■ Example field A ■ Example field B	51.8 47.9	
CEC pot cmol ⁺ /kg	■ Example field A ■ Example field B	17.4 11.8	
CEC act cmol ⁺ /kg	■ Example field A ■ Example field B	6.8 7.3	
CEC plant-available cmol ⁺ /kg	■ Example field A ■ Example field B	2.3 2.2	
Bulk density g/cm ³	■ Example field A ■ Example field B	1.55 1.60	
ENR kg N/ha	■ Example field A ■ Example field B	68 68	
P ₂ O ₅ (CAL) mg/100 g	■ Example field A ■ Example field B	30.0 29.8	
K ₂ O (CAL) mg/100 g	■ Example field A ■ Example field B	11.1 14.3	
Mg (CaCl ₂) mg/100 g	■ Example field A ■ Example field B	8.2 7.7	

Bar length relative to the larger of the two values.

TOTAL DIGESTION — AVAILABLE SHARE OF TOTAL CONTENT (%)

plant-available fraction (H3A) or microbial food in % of total content · grey: total content mg/kg per sample · red mark = target (for target ranges: centre)

Calcium	13.6 1,650 12.9 1,800		(> 8)	●
Magnesium	4.9 1,030 4.6 1,050		(> 5)	●
Potassium	4.5 1,800 5.5 1,800		(> 3)	●
Sodium	9.5 170 5.1 160		(> 3)	●
Phosphorus (PO ₄)	7.3 1,000 7.4 1,000		(> 5)	●
reserve org. P	3.1 1,000 3.0 1,000		(> 5)	●
Sulphur	2.4 400 3.9 200		(> 15)	●
Boron	2.6 7.7 2.8 8.0		(> 8)	●
Copper	1.3 9.3 1.1 9.8		(> 3)	●

NUTRIENT CONTENTS · kg/ha — DEV. FROM TARGET

Sulphur	■ Example field A ■ Example field B	–100.8 –88.0	
Phosphorus	■ Example field A ■ Example field B	+1,009 +1,111	
Calcium	■ Example field A ■ Example field B	–5,605 –2,102	
Magnesium	■ Example field A ■ Example field B	–380 –263	
Potassium	■ Example field A ■ Example field B	–207 +44	
Sodium	■ Example field A ■ Example field B	–47.2 –62.3	
Boron	■ Example field A ■ Example field B	–2.8 –3.1	
Iron	■ Example field A ■ Example field B	+1,445 +1,600	
Manganese	■ Example field A ■ Example field B	–171 –176	
Copper	■ Example field A ■ Example field B	–11.2 –4.8	
Zinc	■ Example field A ■ Example field B	–0.8 –0.8	
Molybdenum	■ Example field A ■ Example field B	–1.5 –1.5	
Cobalt	■ Example field A ■ Example field B	–3.3 –3.5	
Selenium	■ Example field A ■ Example field B	+11.8 +12.6	

FERTILISER RECOMMENDATION · kg/ha

Dolomite	■ Example field A ■ Example field B	4,000 2,260	
Elemental sulphur	■ Example field A ■ Example field B	40 0	
Calcium sulphate (gypsum)	■ Example field A ■ Example field B	520 330	
Kieserite	■ Example field A ■ Example field B	270 220	
Boric acid	■ Example field A ■ Example field B	23 12	
Copper sulphate	■ Example field A ■ Example field B	29 19	
Manganese sulphate	■ Example field A ■ Example field B	50 32	
Rock salt	■ Example field A ■ Example field B	0 47	

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

Green/red dot = within / outside target range (top to bottom Example field A · Example field B). Without target: bars relative to each other. Microbial food C relative to total C, N parameters to total N.