NUTRISPHERE-NL®

Soil nitrogen availability

Nitrate loss reduction

Study & test summary
NIAB & John Innis Centre

VERDESIAN®

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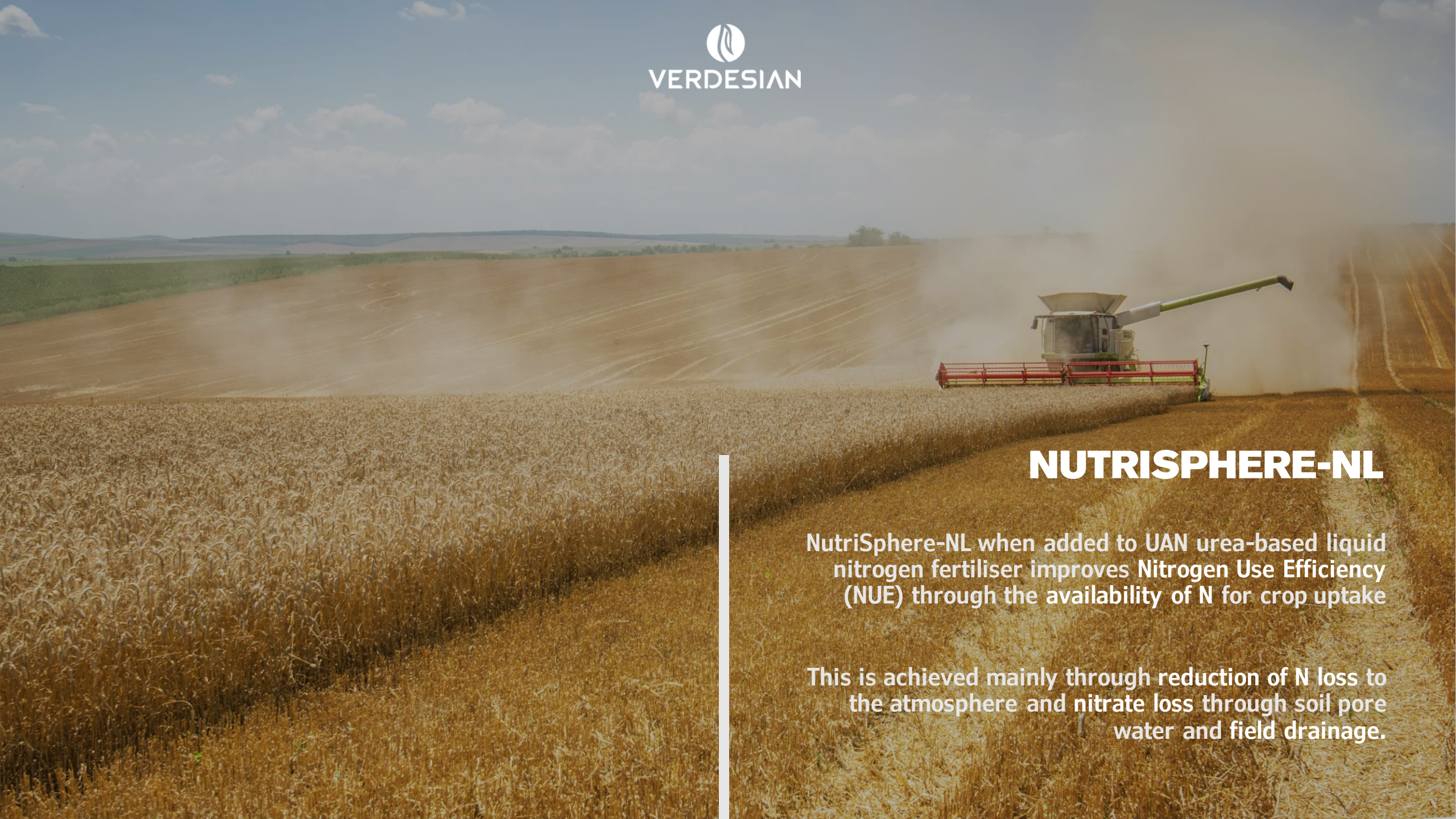

NUTRISPHERE-NL

NutriSphere-NL when added to UAN urea-based liquid nitrogen fertiliser improves **Nitrogen Use Efficiency** (NUE) through the **availability of N** for crop uptake

This is achieved mainly through **reduction of N loss to the atmosphere** and **nitrate loss through soil pore water and field drainage.**

IMPACT

REDUCE

QUALITY

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NUTRISPHERE-NL

Study and test framework

Test centres

The National Institute of Agricultural Botany is a plant science research company based in Cambridge, UK

The John Innes Centre, located in Norwich, Norfolk, England, is an independent centre for research and training in plant and microbial science founded in 1910.

Sponsored

Study & Test

ONE

Drainage and nitrate

Concentration test

NIAB Field Trial

Salle Farms

Norfolk

Sponsored

Study & Test

TWO

Agronomic performance

Replicated Trial

NIAB Field Trial

Morley

Norfolk

Independent

Study & Test

THREE

Soil column

Experiment

John Innes Labatory trial

John Innes Centre

Norwich

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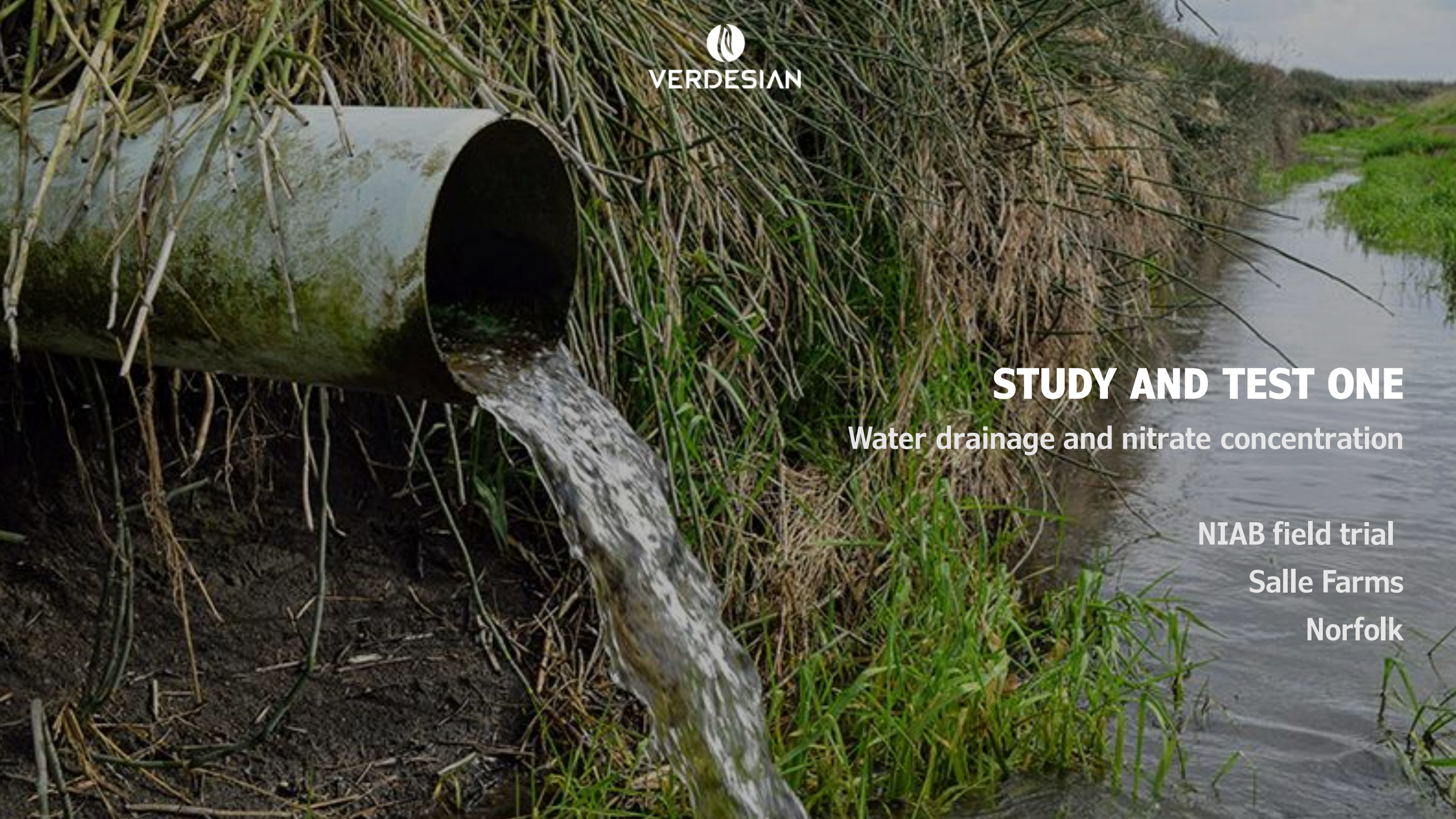

STUDY AND TEST ONE

Water drainage and nitrate concentration

NIAB field trial

Salle Farms

Norfolk

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WATER & NITRATE TEST | NIAB

Objective

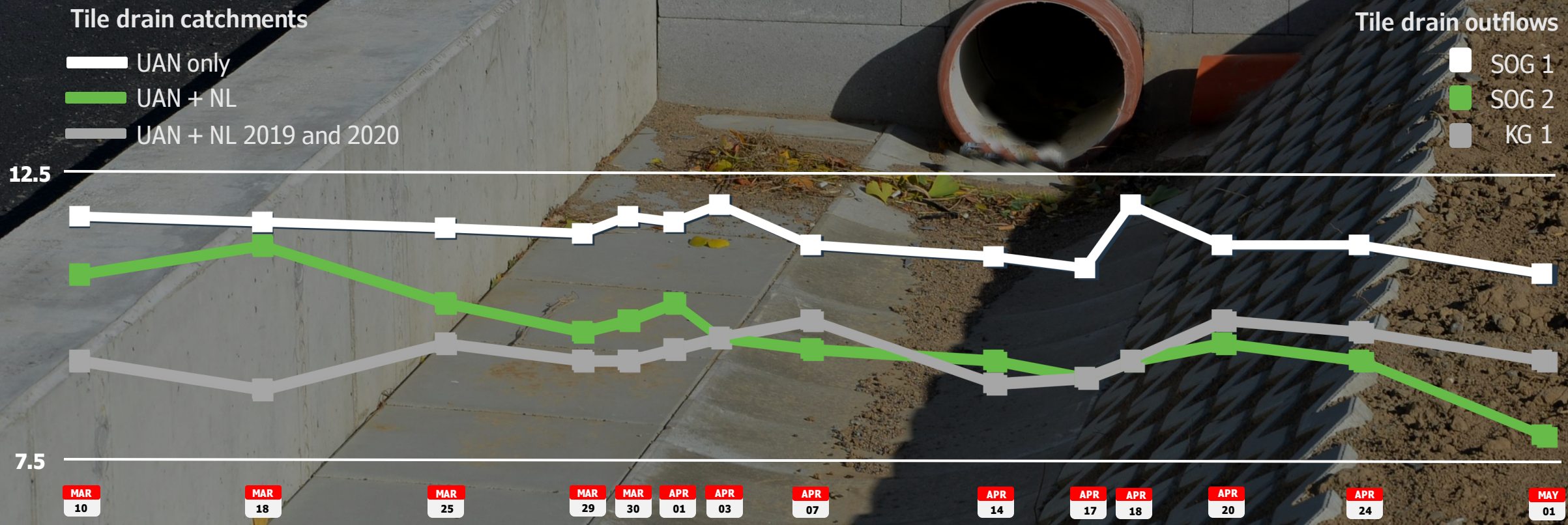
To determine whether NutriSphere NL **reduces nitrate losses** to the field drains

The test scenario was **November 2020**

Method

This test was conducted as a **split field trial**, as the image shows. The location chosen was **Salle Farm, Norfolk**, and was carried out by NIAB.

TILE DRAIN | Concentrations (mg/l)



SOG 1 tile drain outflow had higher nitrate concentrations than outflow from SOG 2 & KG 1, on average **14% higher**

Largest divergence recorded 01/05/2020, SOG 2 compared to SOG 1 was **24% lower nitrate concentration** in the half of the field receiving NutriSphere-NL

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NUTRISPHERE-NL

NITRATE LEACHING REDUCTION

21%

Guthrie Centre
Iowa
USA
2006

RESULTS | Test One

The tile drain nitrate concentration was reduced by an average of 14% through the use of NutriSphere NL

The Guthrie Center Iowa USA had a similar split field trial which achieved a 21% reduction

IMPACT

REDUCE

QUALITY

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STUDY AND TEST TWO

Agronomic performance replicated trial

NIAB Field Trial

Morley

Norfolk

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HOW

Nitrogen availability to the crop was calculated

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AGRONOMIC EFFICIENCY (AE)

The economic production per unit of nutrient uptake

$$AE\ (kg\ kg\text{-}1) = (Gf\text{-}Gu/Na)$$

Gf is the grain yield (grain + straw) fertilised plot

Gu is the grain yield (grain + straw) unfertilised plot

Na is the quantity N fertiliser applied

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PHYSIOLOGICAL EFFICIENCY (PE)

The biological yield obtained per unit of nutrient uptake

$$PE\ (kg\ kg\text{-}1) = (Byf\text{-}byd/Nf\text{-}Nu)$$

Byf is the biological yield (grain + straw) fertilised plot

Byu is the biological yield (grain + straw) unfertilised plot

Nu is the N uptake (grain + straw) N fertiliser applied

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APPARENT RECOVERY EFFICIENCY (ARE)

The nutrient uptake per unit
of nutrient uptake

$$ARE\ (\%) = (Nf\text{-}Nu/Na) \times 100$$

Nf is the N uptake
(grain + straw)
of the fertilised plot

Nu is the N uptake
(grain + straw)
of the unfertilised plot

Na is the quantity
N fertiliser applied

Nutrient utilisation efficiency (NUE) is the product of physiological and apparent recovery efficiency

NUE (kg kg–1) = PE x ARE

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REPLICATED PLOT TRIAL

Application method and treatment

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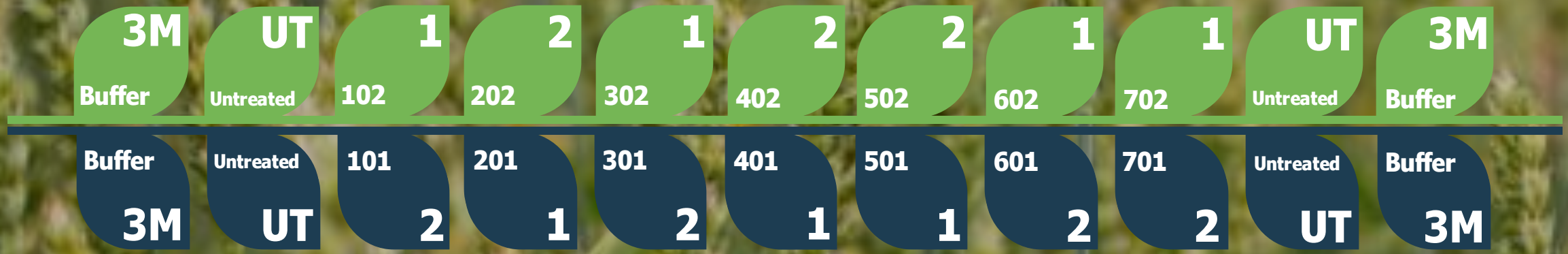
AGRONOMIC PERFORMANCE | Replicated trial



Objective

To quantify if NutriSphere NL improves nitrogen availability to the crop

Method

Replicated plot trial at Morley Farm, Norfolk conducted by NIAB Morely in November 2020

Treatment

1 = Untreated Control (UAN only)

2 = Ttreated UAN with NutriSphere NL

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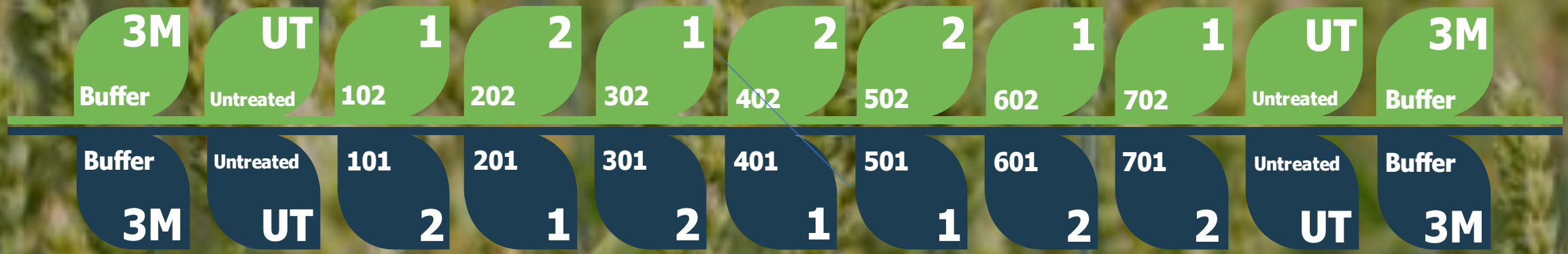
NITROGEN APPLICATIONS | Spring 2020



Application Label	Application Split 1 (applied 06/03/20)	Application Split 2 (applied 15/04/20)	Application Split 3 (applied 27/04/20)
UAN 28	**UAN 28 only** @ 111 l/ha (40 kg N/ha)	**UAN 28 only** @ 334 l/ha (120 kg N/ha)	**UAN 28 only** @ 167 l/ha (60 kg N/ha)
UAN 28 + NUTRISPHERE-NL	**UAN 28** @ 111 l/ha (40 kg N/ha) **+ NutriSphere-NL**	**UAN 28** @ 334 l/ha (120 kg N/ha) **+ NutriSphere-NL**	UAN 28 @ 167 l/ha (60 kg N/ha) **+ NutriSphere-NL**

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OUTCOMES AND KEY FACTS

Soil Mineral Nitrogen, Nitrate and Ammonium

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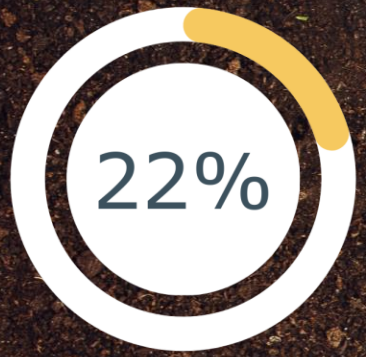
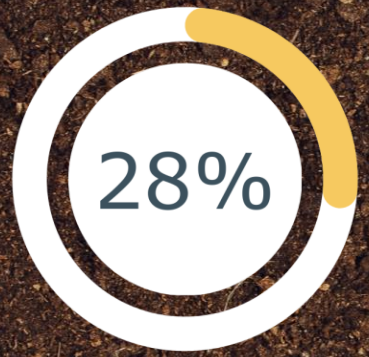
KEY FACTS | Total soil mineral nitrogen

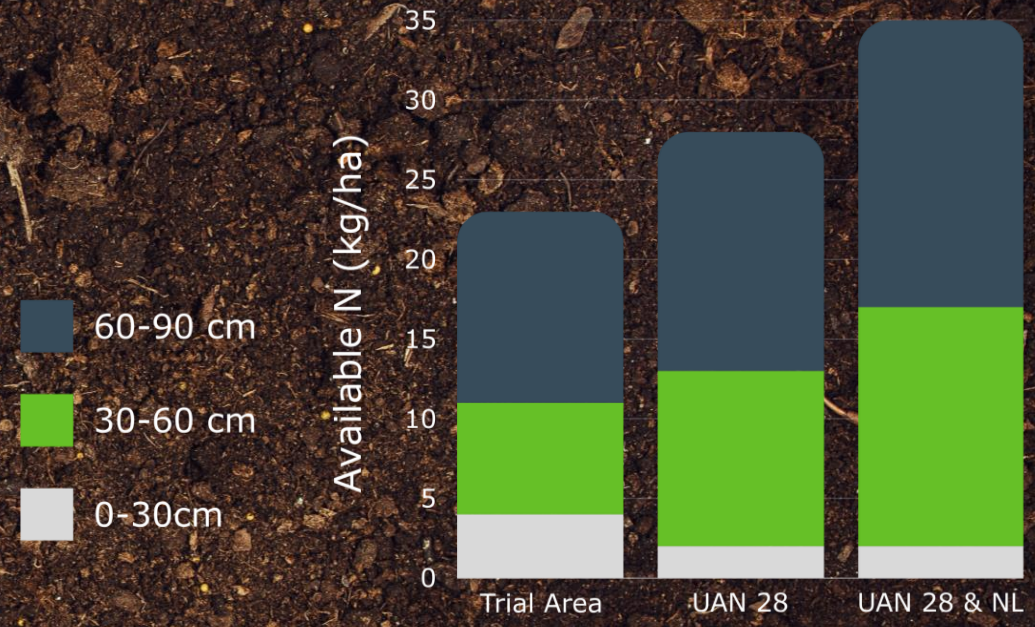
Soil type : Sandy Loam (light)



Over a period of 6 months the SMN was 22% higher with the UAN + NL treatment, compared to the UAN alone



A similar sponsored test was conducted by Campden BRI in 2018 and demonstrated a similar uplift of 28% of SMN compared to untreated UREA.



Trial Area baseline result of 23 kg/ha available N | February 2020
UAN 28 and UAN 28 & NL | August 2020

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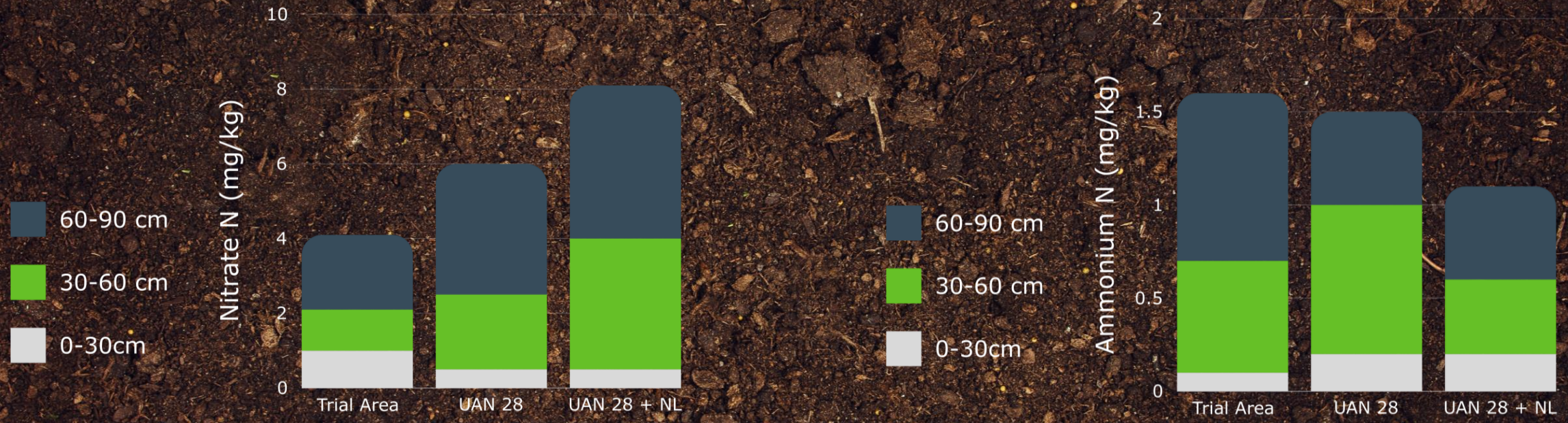
KEY FACTS | Soil nitrate and ammonium

Soil type : Sandy Loam (light)



Soil nitrate N (mg/kg) and b) ammonium N (mg/kg), assessed at intervals through the growing season (Feb 2020 to Aug 2020)

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NUTRISPHERE-NL

SOIL NITRATE CONMCENTRATION

35%

Higher with NutriSphere NL

KEY FACTS: Soil nitrate concentration

The August timing shows differences between treatments, recording 35% higher (2.1 mg/kg) soil nitrate concentrations where NutriSphere-NL was applied.

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OUTCOMES AND KEY FACTS

Crop biomass, grain yield and nitrogen uptake

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KEY FACTS | Crop biomass, grain yield and nitrogen uptake

NUTRISPHERE-NL

GRAIN YIELD INCREASE

2.6%

0.3 t/ha INCREASE

An increase in average grain yield of 0.3 t/ha (+2.6%) where NutriSphere-NL was applied

NUTRISPHERE-NL

GRAIN WEIGHT INCREASE

1.5%

1.1 kg/hl INCREASE

Grain weight increased from 74.4 to 75.5 kg/hl, where NutriSphere-NL was applied

NUTRISPHERE-NL

NITROGEN INCREASE

1.1%

0.02G/100G INCREASE

Nitrogen content UAN 1.81g/100g dmb to UAN + NL 1.83g/100g dmb

NUTRISPHERE-NL

PROTEIN INCREASE

1.1%

0.11% dmb INCREASE

Protein content UAN 10.34% dmb to UAN + NL 10.45% dmb

All statistically significant results P= 0.1
Dmb = Dry matter basis

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KEY FACTS | Crop biomass, grain yield and nitrogen uptake

NUTRISPHERE-NL

STRAW NITROGEN

5.9%

1.9 kg N/ha dmb INCREASE

NUTRISPHERE-NL

GRAIN NITROGEN

3.5%

6.3 kg N/hl dmb INCREASE

NUTRISPHERE-NL

NITROGEN TOTAL UPTAKE

4.0%

8.8 KG N/ha dmb INCREASE

Both straw and grain nitrogen uptake increased (by 5.9% and 3.5% respectively), when NutriSphere-NL was added to UAN

Mean total nitrogen (straw + grain) increased 4.0% from 211.3 to 219.8 kg N/ha, when NutriSphere-NL was added to UAN, reflecting increased Nitrogen Use Efficency

Dmb = Dry matter basis

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KEY FACTS | Crop biomass, grain yield and nitrogen uptake

NUTRISPHERE-NL

AGRONOMIC EFFICENCY

5.4%

INCREASE

Agronomic efficiency increased 5.4%, from 17.59 to 18.55 kg nitrogen harvested per kg nitrogen applied, when NutriSphere-NL was added to the UAN

NUTRISPHERE-NL

APPARENT RECOVERY EFFICENCY

6.1%

INCREASE

Apparent Recovery efficency which is the quantity of nutrient uptake per unit of nutrient applied increased by 6.1%

NUTRISPHERE-NL

COMBINED EFFICENCY

11.8%

INCREASE

The Agronomic and Apparent Recovery efficiency increase of 11.8% from 11.2 to 12.5kg N /fertiliser N, when NutriSphere-NL was added to the UAN

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RESULTS | TEST TWO

NUTRISPHERE-NL

NUTRIENT UTILISATION EFFICENCY

11.8%

INCREASE 11.2 TO 12.5 KG/N

NUTRISPHERE-NL

CEREAL YIELD INCREASE

3.0%

INCREASE 2015 TO 2021 EU TESTS

Crop yield response was around 0.3 t/ha at Morley, which was statistically significant at P=0.1, suggesting improved nitrogen use efficiency when the fertiliser was treated with NutriSphere-NL

The increases in cereal yields support European research by Verdesian over a period of 6 years 2015-2021, where yields in all crops tested have shown to increase on average by 3%

IMPACT

REDUCE

QUALITY

VERDESIAN

STUDY AND TEST THREE

Soil column experiment

John Innes Laboratory
John Innes Centre
Norwich

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NUTRISPHERE-NL

SOIL COLUMN EXPERIMENT

2019
2020

Nitrate Concentrations

SOIL COLUMN EXPERIMENT | The John Innes Centre

Objective

To examine whether nitrate distribution patterns down the soil profile are affected by the use of NutriSphere-NL with UAN urea-based liquid nitrogen fertiliser

To quantify whether the use of NutriSphere-NL changes the short-term composition and structure of the microbial community

Method

This report focusses on the work looking at nitrate concentrations in soil columns in two seasons (2019) and (2021)

Soil used in columns experiment taken from Salle Farms

SOIL COLUMN EXPERIMENT

Trial methodology

01

Watering Routine

3x / week
Applied at 500 ml (= 18.6mm rainfall)
Increased to 1,000 ml from 19th April 2021

02

Data Analysis

Bacterial assessment: Shannon diversity index; formulae for entropy & estimating species diversity

03

Germinated

Wheat seed In water for 3 days

04

Grown

For 4 days before planting in glass column

05

Grown

In soil for 7 days, first fertiliser treatment

06

Grown

In soil for 32 days, second fertiliser treatment

07

Data Analysis

Harvest biomass

IMPACT

REDUCE

QUALITY

VERDESIAN

KEY FACTS | Soil pore water : Nitrate Concentration (mg/kg)

NUTRISPHERE-NL

TOP LAYER

33%

LOWER

Nitrate Concentrations

NUTRISPHERE-NL

MIDDLE LAYER

0%

UNDECTABLE

Nitrate Concentrations

NUTRISPHERE-NL

BOTTOM LAYER

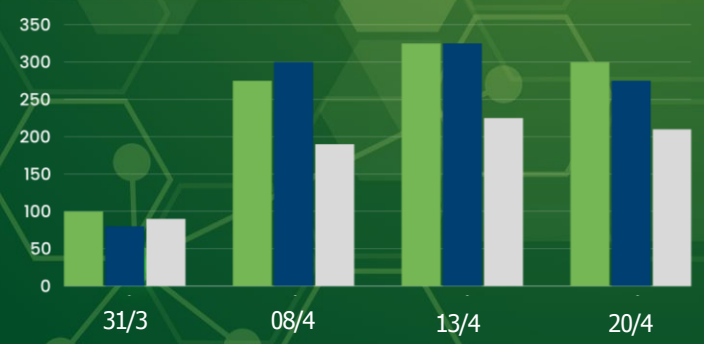
75%

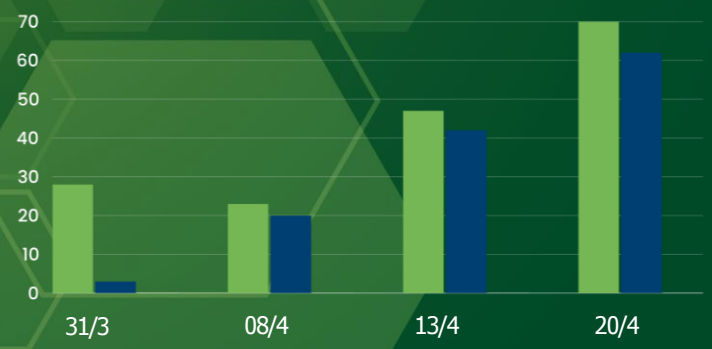
REDUCTION

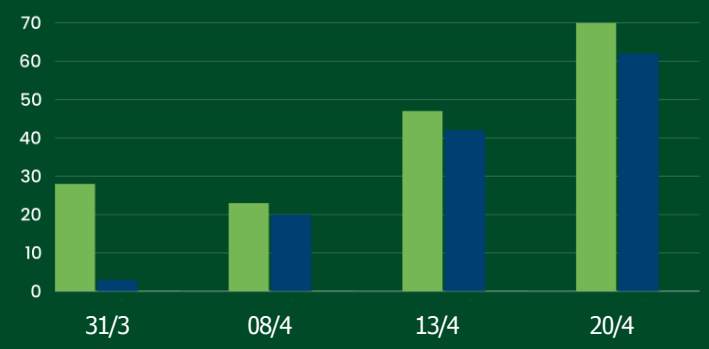
Soil Pore Water

Treatment key

- CAN
- UAN
- NutriSphere NL







Soil pore water for NO_3 and NH_4 concentrations in the top layer were found lowest with UAN + NutriSphere-NL

Readings taken at weekly intervals in the top, middle and bottom layers for the first nitrogen fertiliser application in 2021
Where no bars shown, the values were undetectable and treated as zero. Error bars are SE of mean of 3 samples

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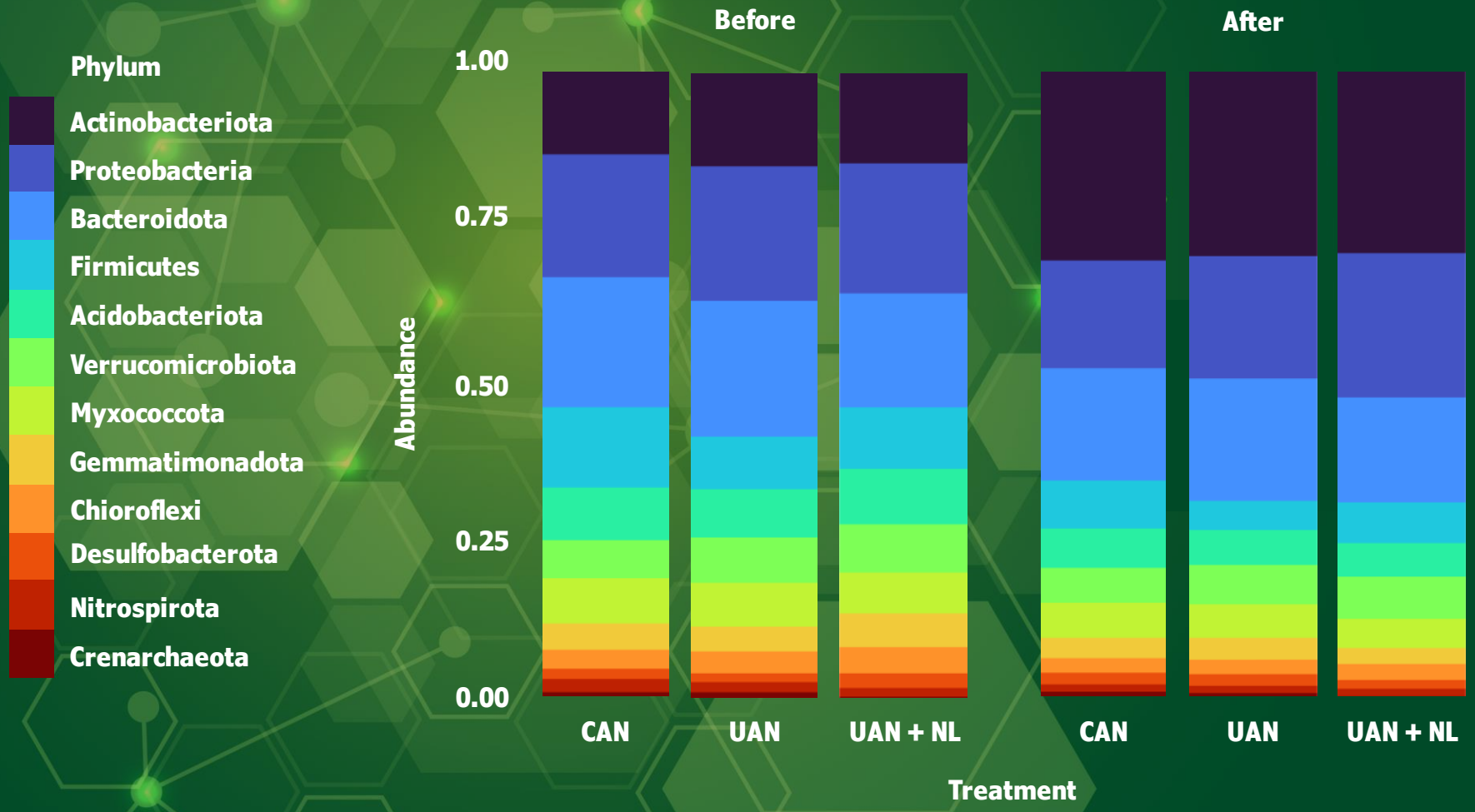

16S Metabarcoding

The relative abundance of phyla found in the soil bacterial communities, as sampled and fingerprinted through 16S metabarcoding shows that the communities did not differ among the fertiliser treatments

The soil bacterial community changed significantly between the first and second sampling in all treatment This may result from the application of fertiliser, but it may also be a result of the root exudates associated with the growing wheat

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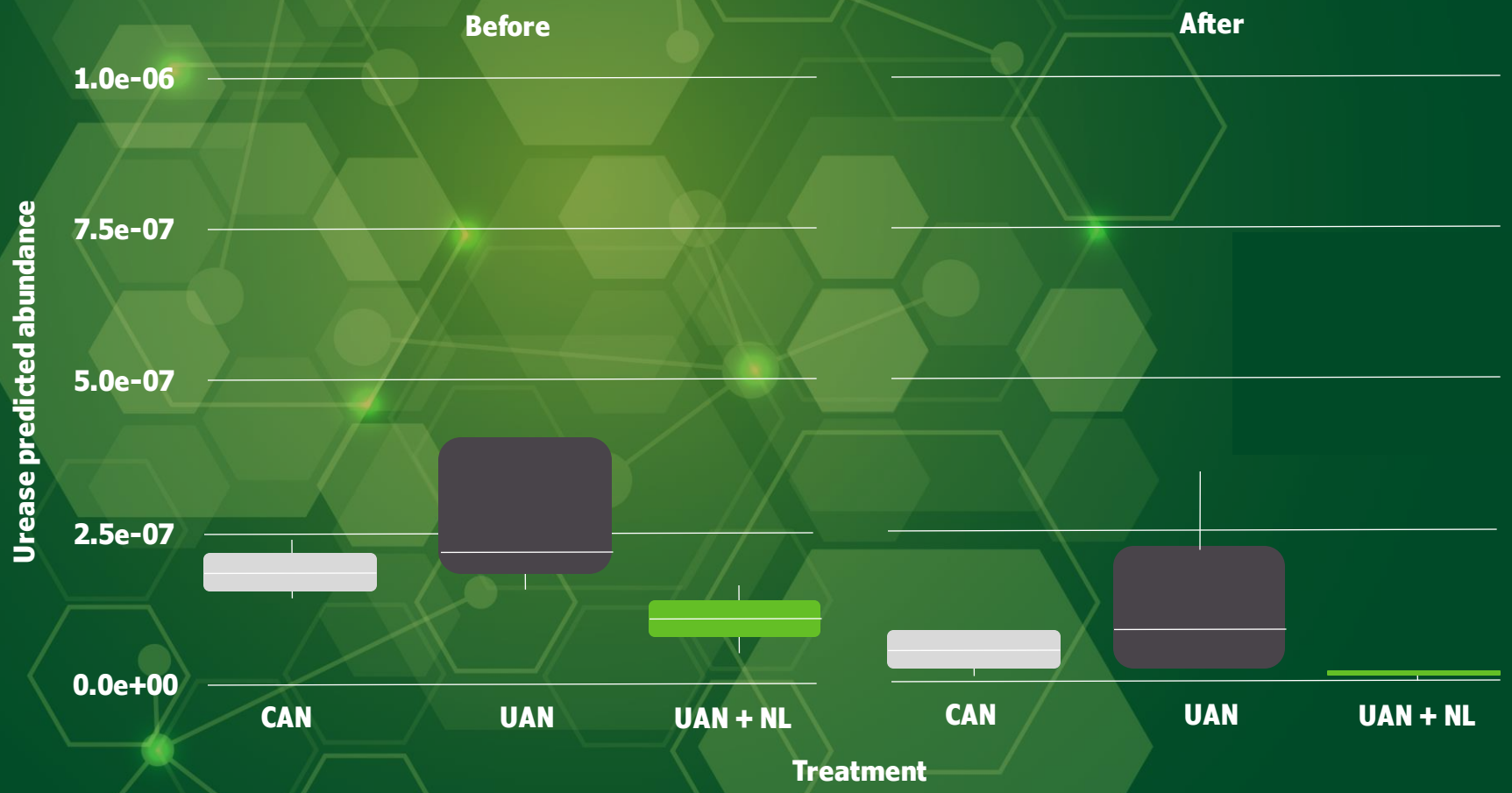
KEY FACTS | Taxa capable of synthesising urease



Microbial Diversity Results

NutriSphere-NL completely suppresses urease activity

Nutrisphere-NL treatment has an almost undetectable abundance of Taxa capable of synthesising urease.

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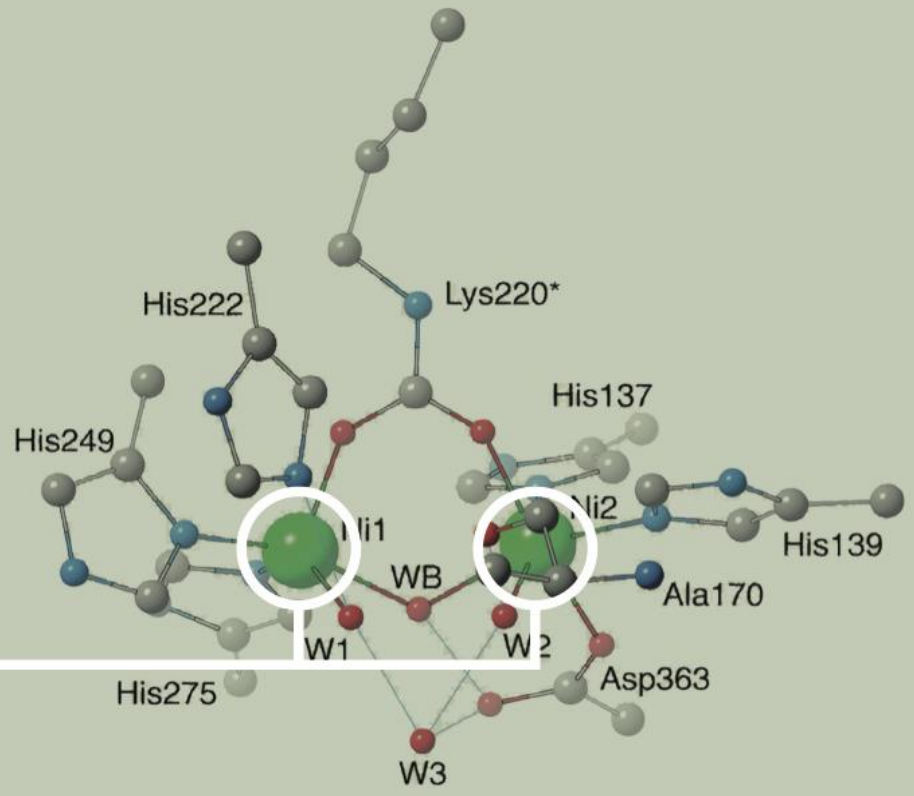
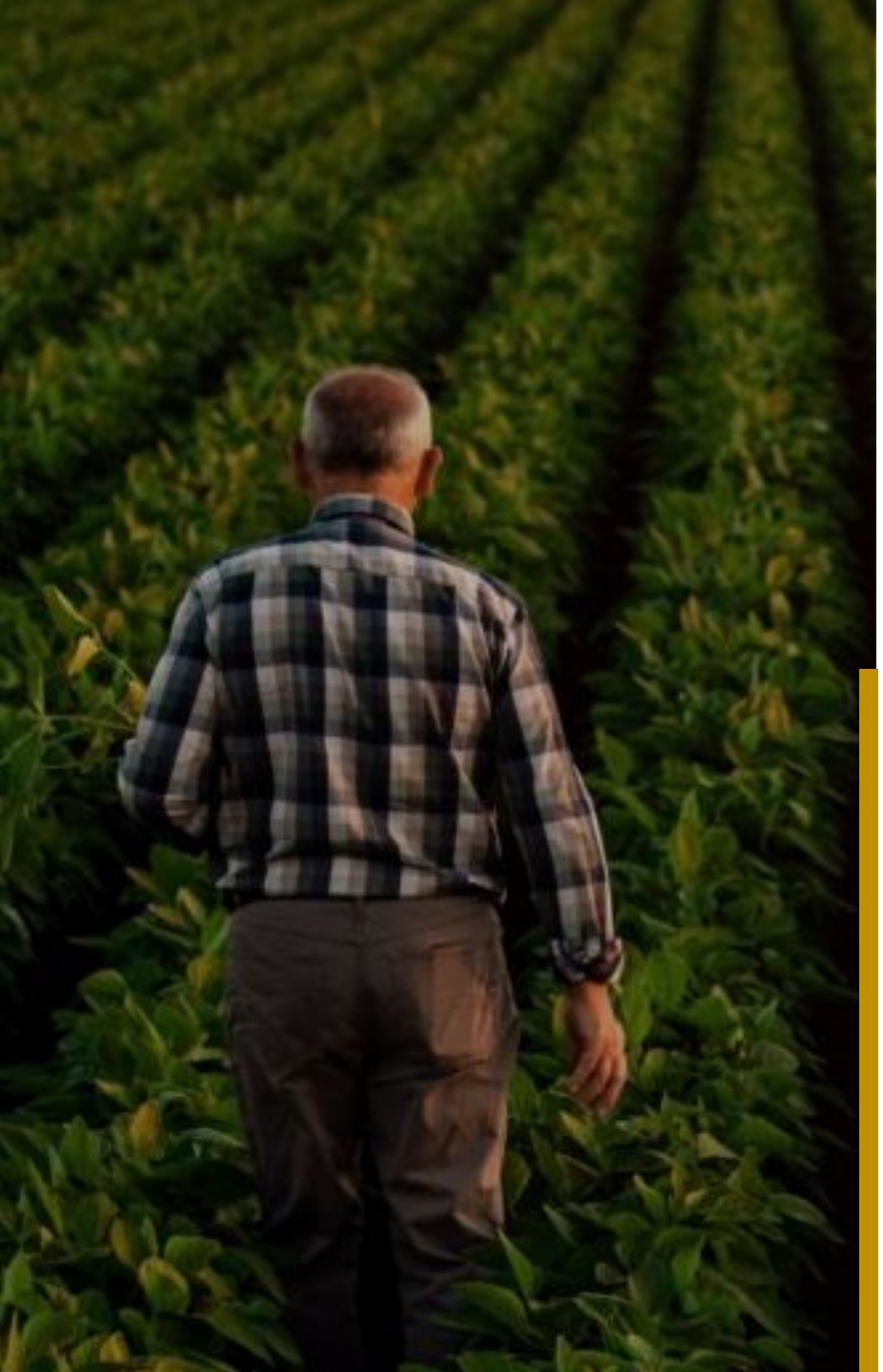
NUTRISPHERE NL | Mode of action

NUTRISPHERE NL takes the nickel away



- NutriSphere NL enables more of the applied nitrogen to be available to the



KEY FACTS | NutriSphere NL is a UREASE inhibitor

IMPACT

Achieves zero impact on soil biome

REDUCE

Enables nitrogen inputs to be reduced

QUALITY

Proven Quality through improved NUE

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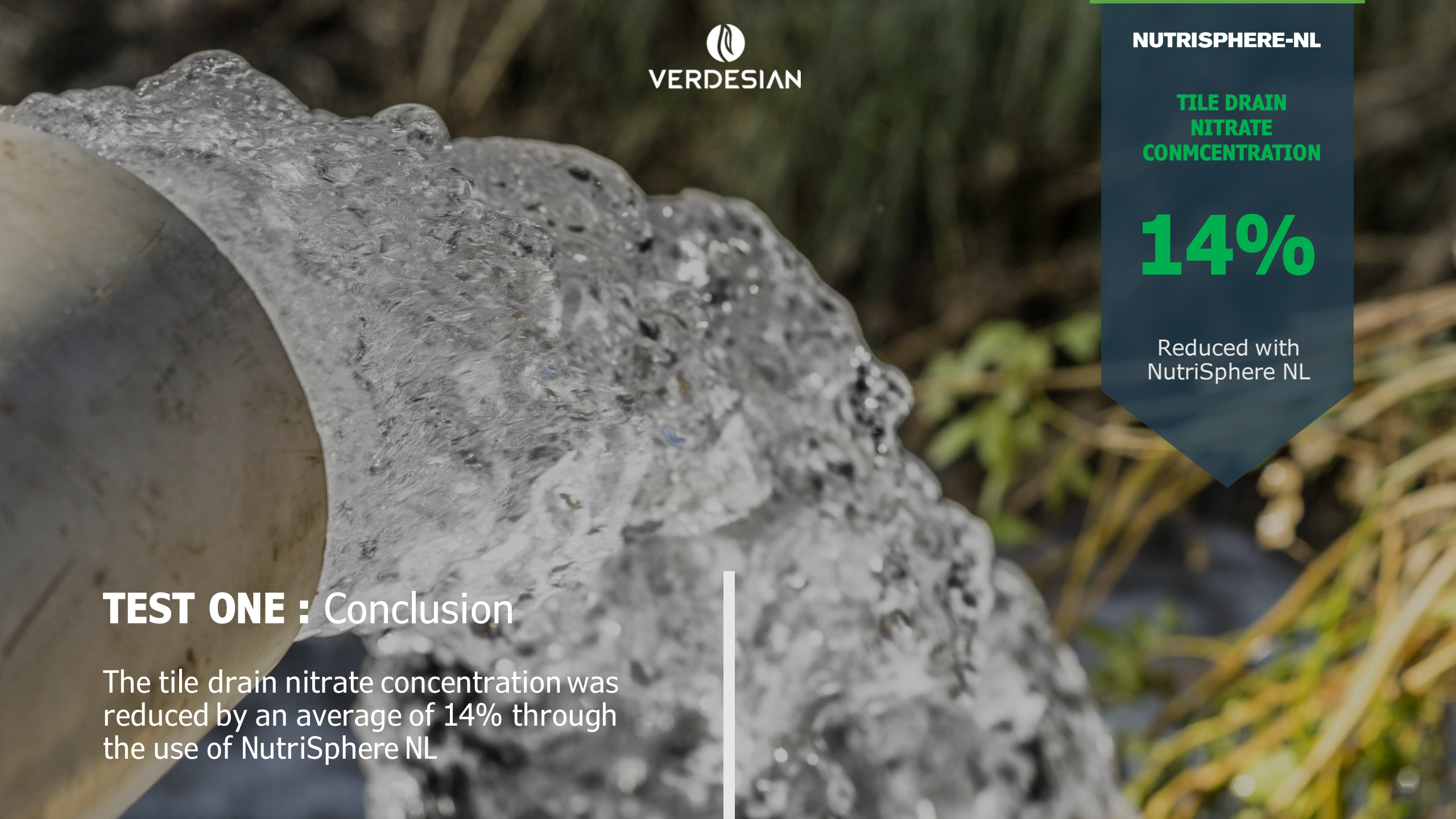
NUTRISPHERE-NL

ALL STUDIES AND TESTS

Key outcomes



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NUTRISPHERE-NL

TILE DRAIN NITRATE CONMCENTRATION

14%

Reduced with NutriSphere NL

TEST ONE : Conclusion

The tile drain nitrate concentration was reduced by an average of 14% through the use of NutriSphere NL

NUTRISPHERE-NL

YIELD AND CROP NITROGEN CONTENT

11.8%

Increase with NutriSphere NL

TEST TWO : Conclusion

Yield and crop nitrogen content were higher on average with NutriSphere-NL added to UAN.

Crop yield response results had improved nitrogen use efficiency (NUE) when the fertiliser was treated with NutriSphere-NL.

Achieved an 11.8 % increase in Nutrient Utilisation Efficiency where NutriSphere-NL was applied

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NUTRISPHERE-NL

EU CE MARK ACCREDITATION

UREASE INHIBITOR (PFC5)

EU Regulation 2019/1009 (FPR)

TEST THREE : Conclusion

UAN + NL, has demonstrated a significant reduction in nitrates contained in the soil pore water by between 33% and 75%.

Based on the microbial diversity studies and the resulting taxa. The application of NutriSphere-NL completely suppressed urease activity.

This is further confirmed by the granting of the CE mark for Nutrisphere NL as a urease inhibitor (PFC5) under the EU Regulation 2019/1009 (FPR)

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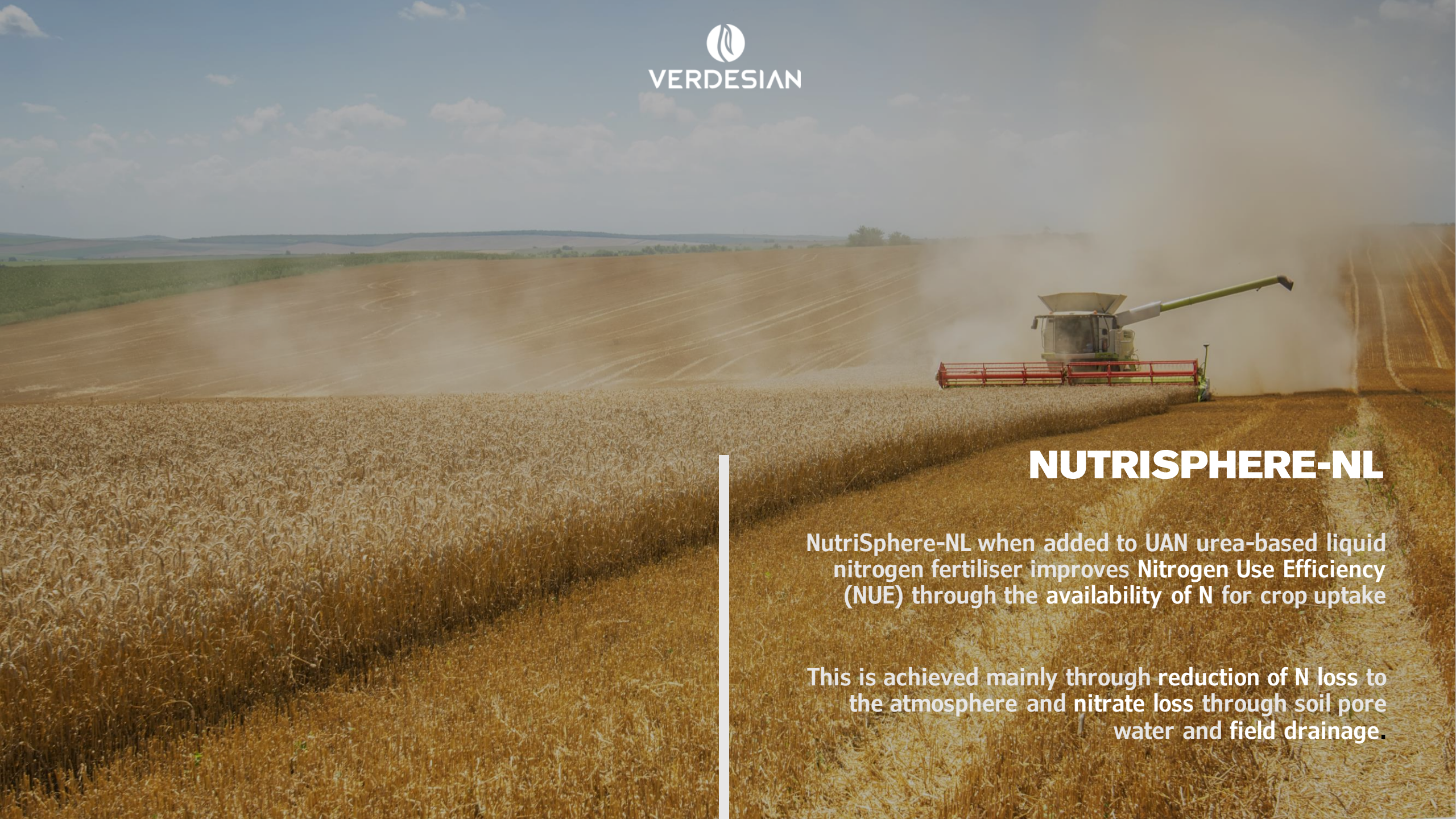

NUTRISPHERE-NL

NutriSphere-NL when added to UAN urea-based liquid nitrogen fertiliser improves **Nitrogen Use Efficiency** (NUE) through the **availability of N** for crop uptake

This is achieved mainly through **reduction of N loss to the atmosphere** and **nitrate loss through soil pore water and field drainage**.

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THE NUTRIENT USE EFFICIENCY PEOPLE™

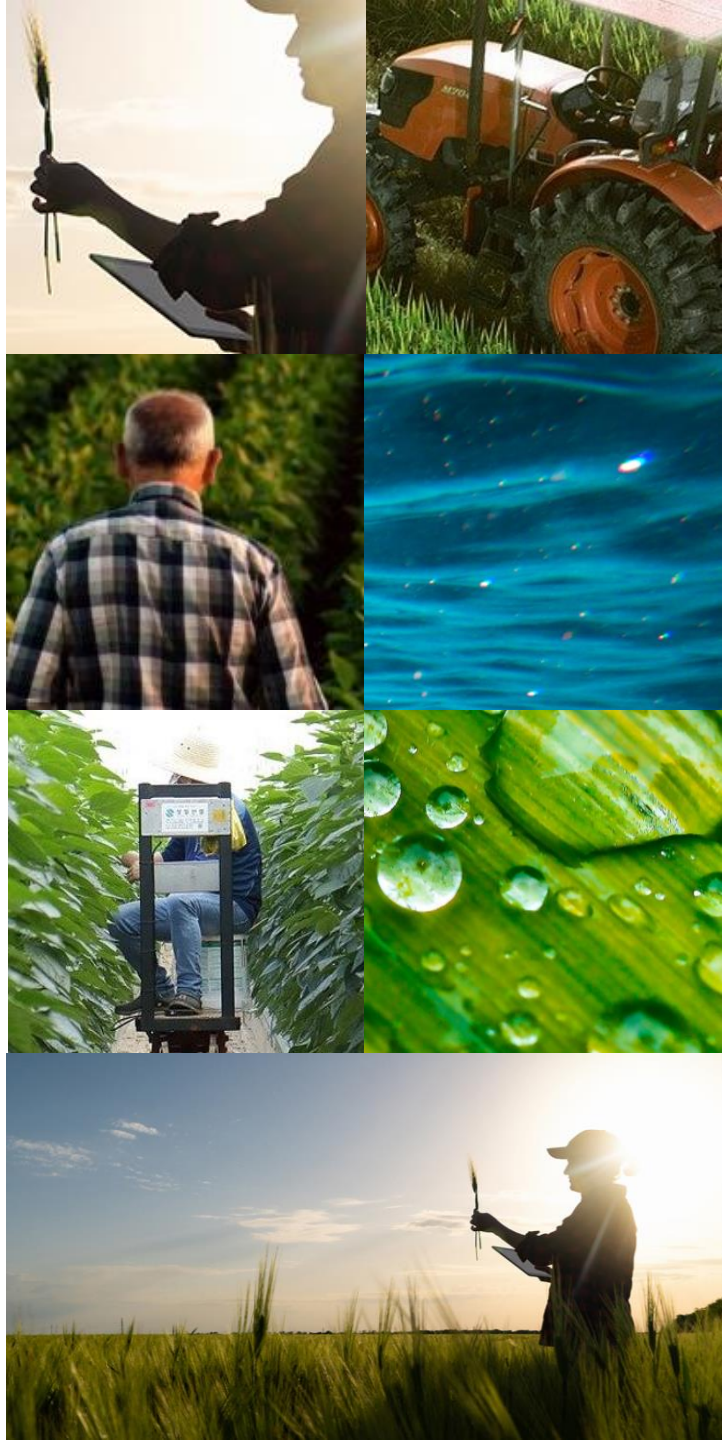
Department
for Environment
Food & Rural Affairs

NUTRISPHERE-NL

Official DEFRA figures for urea-based fertilisers and urease inhibitors (UI), sold onto UK farms, confirm that NutriSphere NL has the highest annual offtake between 2021/23, and is **56%** of the urease inhibitor treated UAN market.

STUDIES AND TESTS | **Summary**

- Proven quality through improved NUE
- Reduced nitrogen inputs through increased efficiency
- Achieves zero impact on soil biome
- Suppresses urease activity
- Reduces environmental impact of nitrate loss into waterways
- Improves yield response to nitrogen



IMPACT

REDUCE

QUALITY

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www.eu.vlsci.com

John Innes Centre
Unlocking Nature's Diversity

NIAB