



A new controlled-release fertilizer with a fully biodegradable coating reduces nitrogen losses to the environment

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Introduction

Nitrogen (N) is crucial for plant nutrition and agricultural systems' sustainability and economic viability¹. N is highly dynamic thus it challenging to efficiently manage it, particularly in intensive agricultural systems where huge N inputs may lead to substantial losses through surface runoff, leaching to ground waters, and gaseous emissions to the atmosphere. There are several ways to reduce the risk of N losses, like urease inhibitors, nitrification inhibitors, and controlled-release fertilizers (CRFs). The challenge of new fertilizer technologies is to reduce N losses from agricultural systems and to increase Nitrogen Use Efficiency (NUE)².

This study aimed to assess N loss reduction to the environment when using CRFs compared to uncoated urea.

Materials and Methods

Experimental design

The trial was executed by NMI b.v. (Nitrogen Management Institute, The Netherlands) in 2021.

A pot experiment with red beetroot (*Beta vulgaris vulgaris*) was set up using loamy-sandy soil with a high pH (>7.5). The experiment consisted of four treatments

1. Zero N (control)
2. Urea 46%N | 1 x N | 100% N rate as base fertilizer
3. Urea 46%N | 2 x N | 50% as base fertilizer and 50% as top-dressing
4. CRF* 40%N | 1 x N | 100% N rate as base fertilizer

The trial was set up in a randomized block design with 4 replicates per treatment. All treatments received 150 kg N ha⁻¹, full rate as base fertilization or split applications, except for the control. All treatments received the same amount of P, K, Ca, Mg, and S.

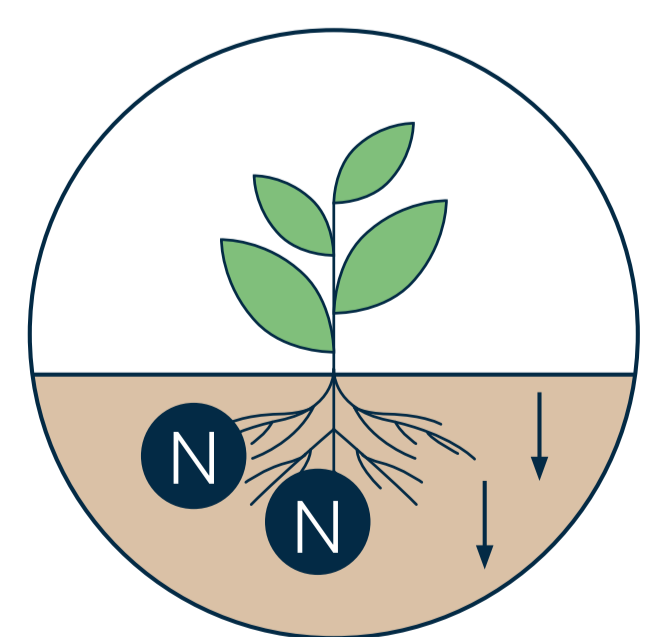
* The CRF product is fully coated urea by ICL's new biodegradable coating technology - eqo.x®

Measurements

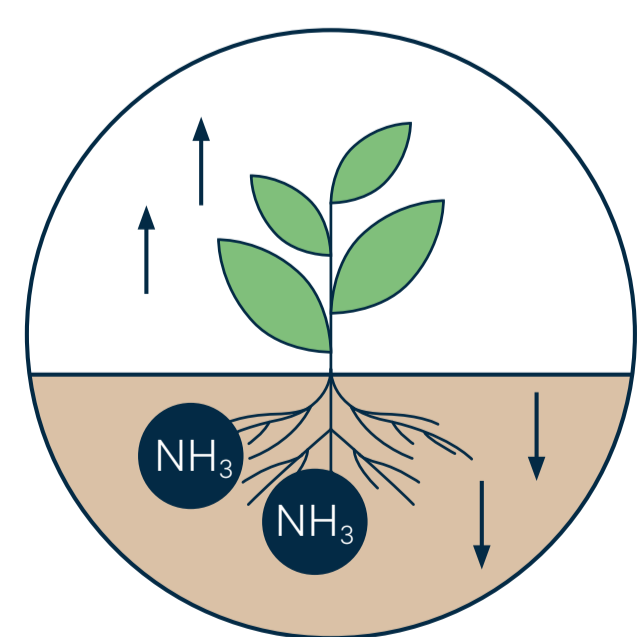
NH₃ and N₂O emissions, and total N leached were measured throughout the trial. At the trial's end, total plant biomass and Nitrogen Use Efficiency were assessed.

Conclusions

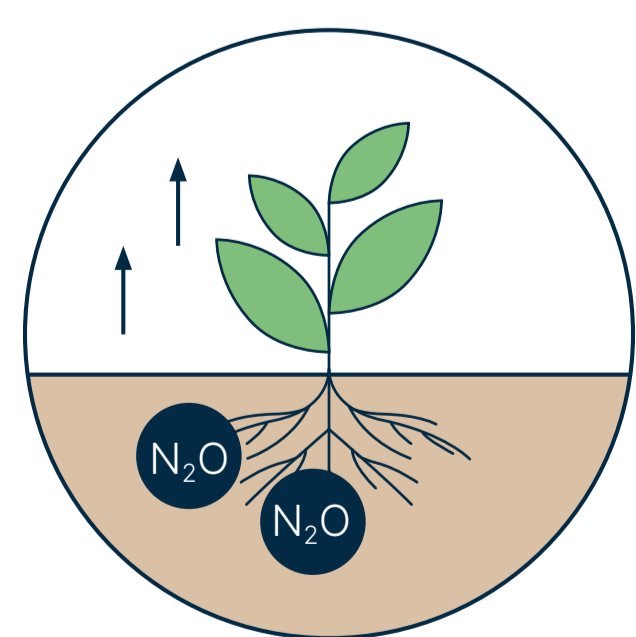
Compared to regular urea, CRFs



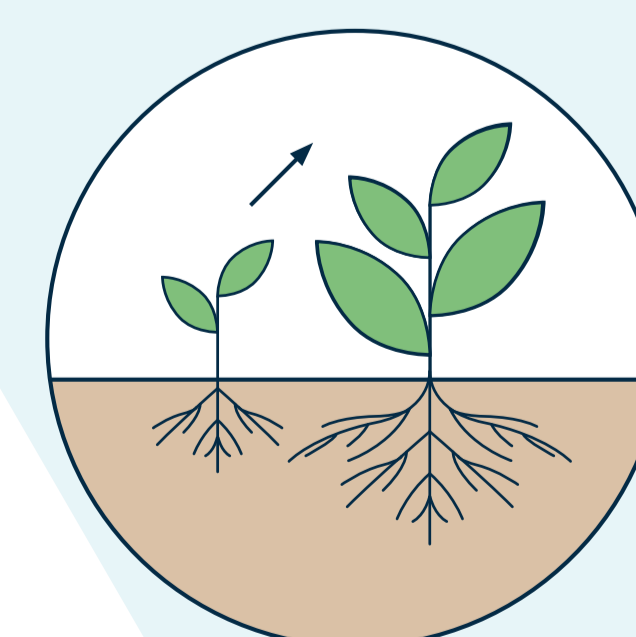
Reduce N leaching, up to 60%



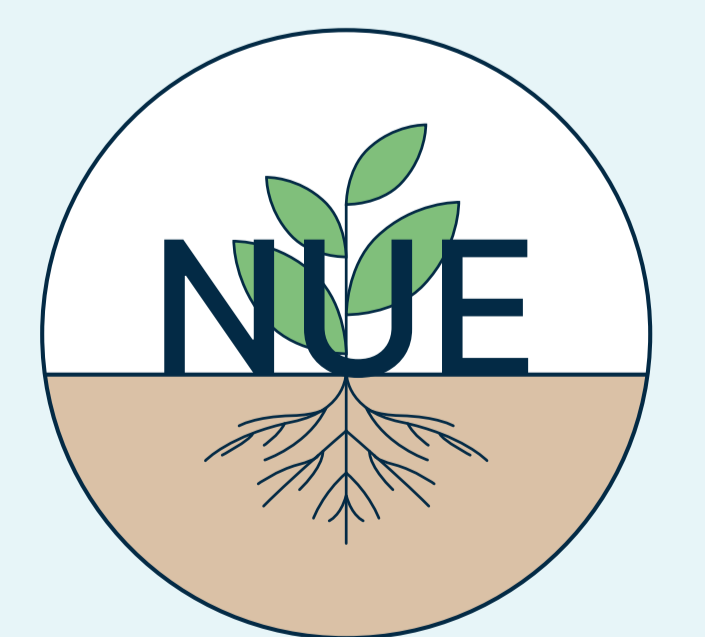
Reduce NH₃ volatilization, up to 60%



Reduce N₂O emissions, over 10%



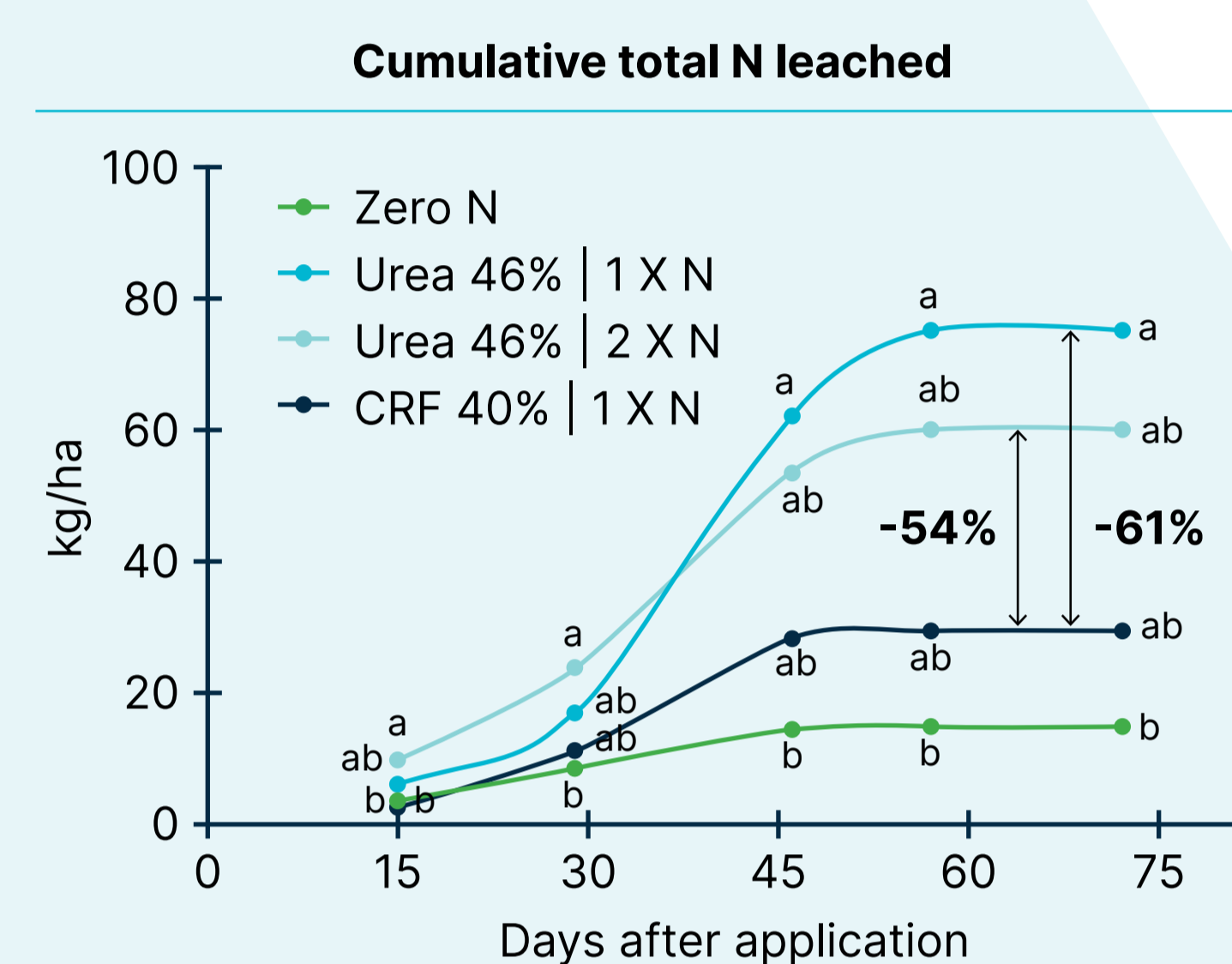
Increase yield by more than 30%



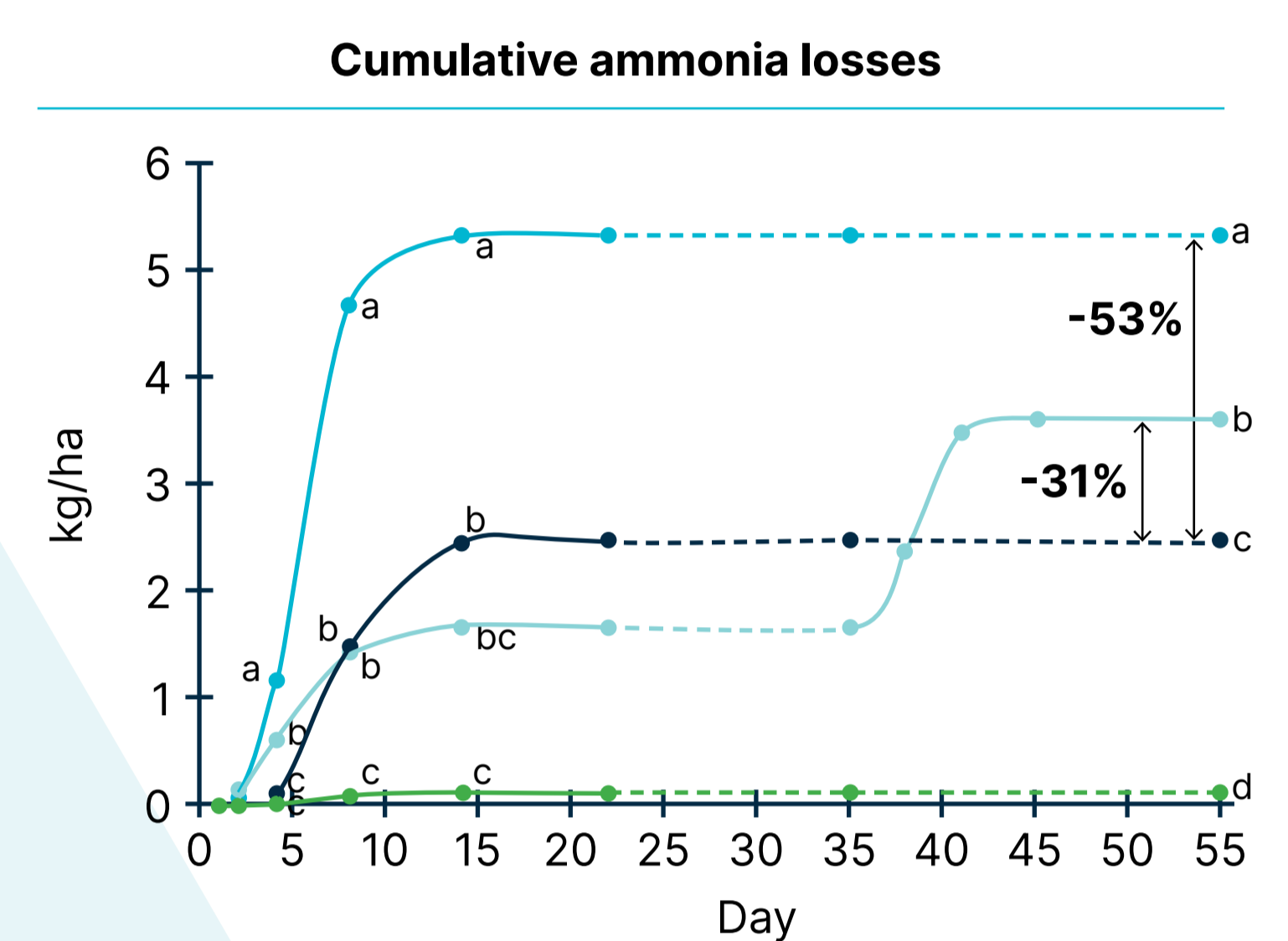
Increase NUE by more than 80%

References: ¹ Zaman, M., & Blennerhassett, J. D. (2010). Effects of the different rates of urease and nitrification inhibitors on gaseous emissions of ammonia and nitrous oxide, nitrate leaching and pasture production from urine patches in an intensive grazed pasture system. *Agriculture, Ecosystems and Environment*, 136(3–4), 236–246.
² Minato, E. A., Cassim, B. M. A. R., Besen, M. R., Mazzi, F. L., Inoue, T. T., & Batista, M. A. (2020). Controlled-release nitrogen fertilizers: Characterization, ammonia volatilization, and effects on second-season corn. *Revista Brasileira de Ciencia Do Solo*, 44.

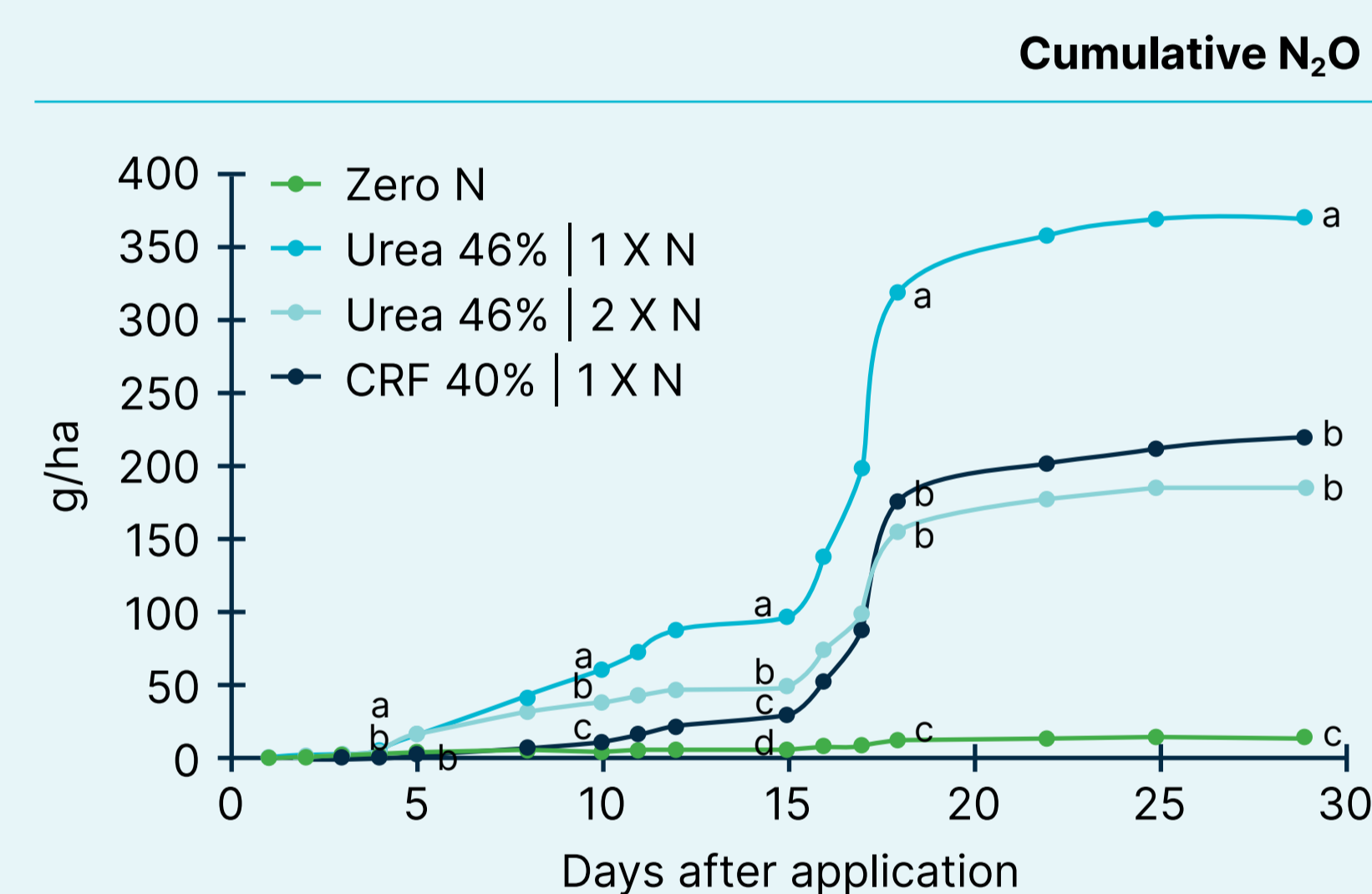
Results



After 72 days, by using CRF 40%N, total N lost by leaching was reduced, in average, by 58% compared to conventional urea.



After 14 days, N losses as NH₃ volatilization were significantly reduced by 53% comparing CRF 40%N with Urea 46%N, applied at the same time and rate, and by 31% when compared to split application of urea.

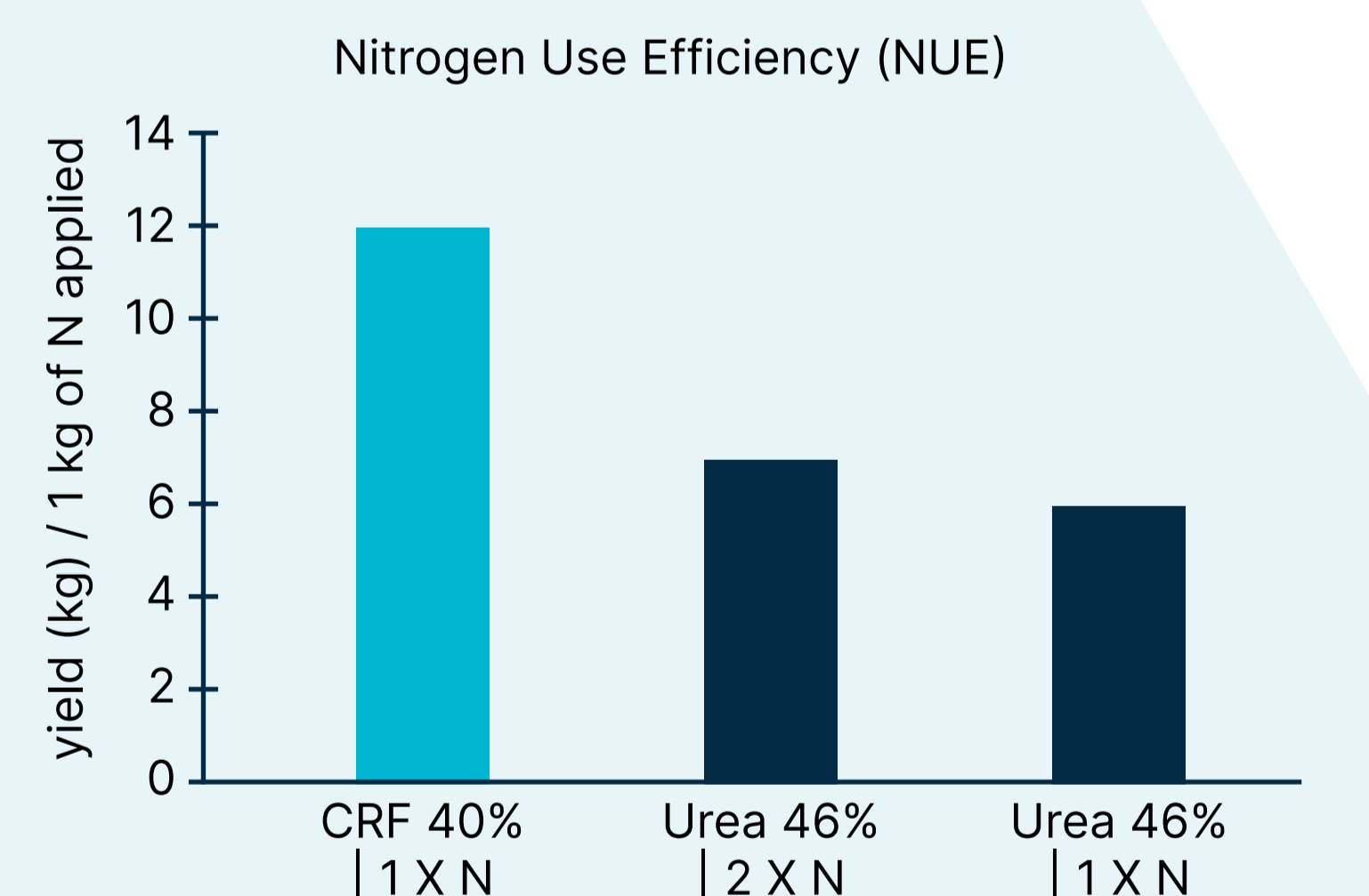
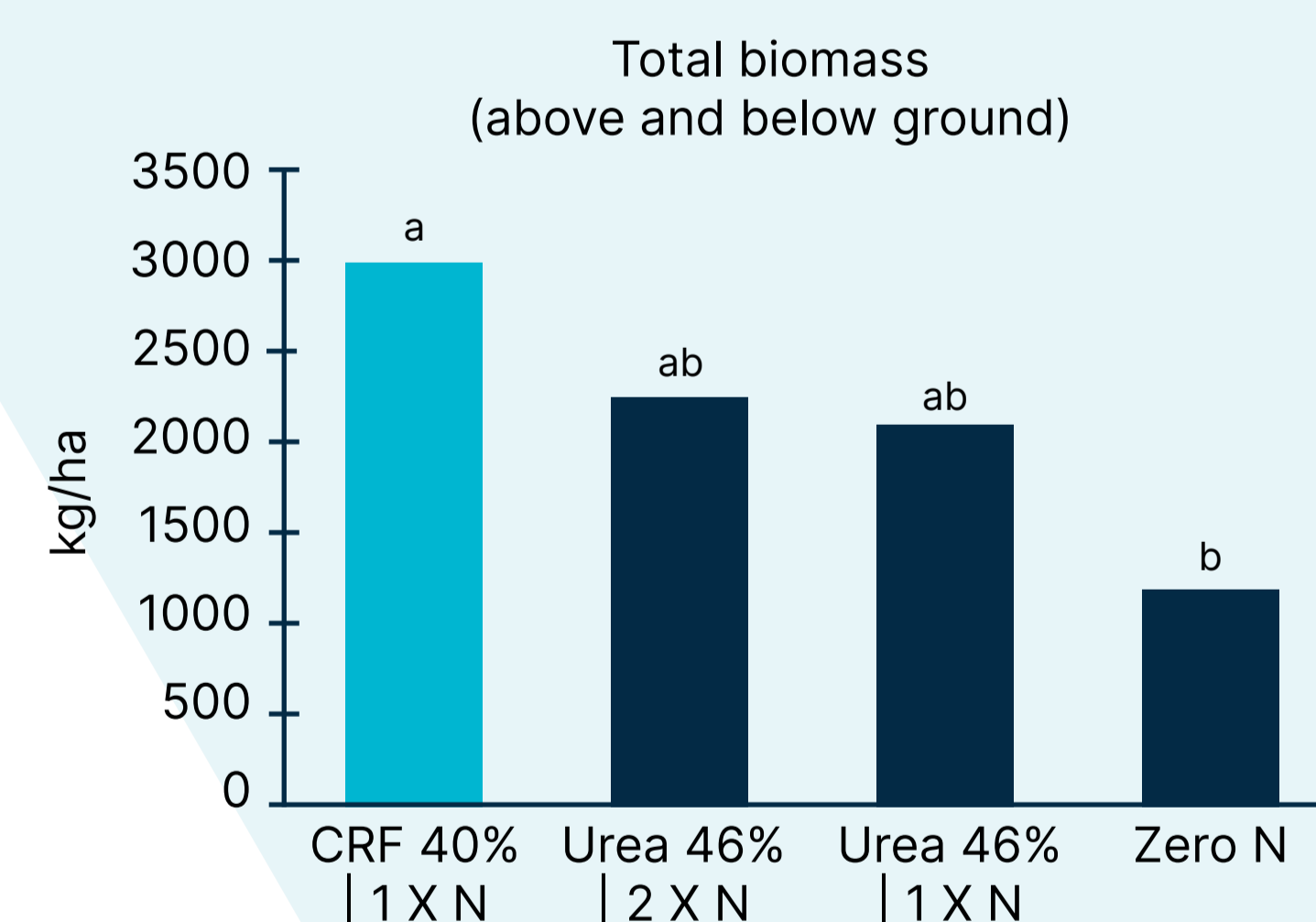


In the first 30 days, N losses as N₂O were significantly higher for Urea 46%N | 1 x N compared to split application of urea and CRF 40%N. At this moment, Urea 46%N | 2 x N received only 50% of the total N.

The N₂O emissions after 72 days varied between 0.17 and 0.5 kg N/ha but there were no statistically significant differences between treatments for the total cumulative N₂O emissions.

However, CRF 40%N lowered N₂O emissions by -11% compared to regular urea applied at the same rate and time.

Improved yield and Nitrogen Use Efficiency



Less N losses lead to higher NUE therefore higher yields. In this trial, CRF 40%N improves NUE by more than 80% and increases yield by more than 30% compared to average results recorded by both treatments where urea was used.

NUE calculated as Agronomic Efficiency = (YF-Y0)/N applied
Different letters indicate significant differences (p < 0.05).