Exploring the use of organo-mineral fertilisers for sugar beet nutrition

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Introduction

Nitrogen fertilisers are a major contributor to agricultural greenhouse gas emissions. Ammonium nitrate (AN) fertiliser alone accounts for a substantial proportion of emissions associated with crop production, arising both from fertiliser manufacture and the release of nitrous oxide (N_2O) following field application.

A range of lower-emission fertiliser technologies are becoming available. These include slow-release and organic matter-based fertilisers e.g OMF, CCm, which aim to reduce nitrogen losses through more gradual nutrient release. While these products show promise, there is limited independent evidence of their performance in sugar beet systems and concern over their slow-release properties.

This research aims to:

1. Identify if alternative lower emission N products are viable to use in sugar beet crops

Materials and Methods

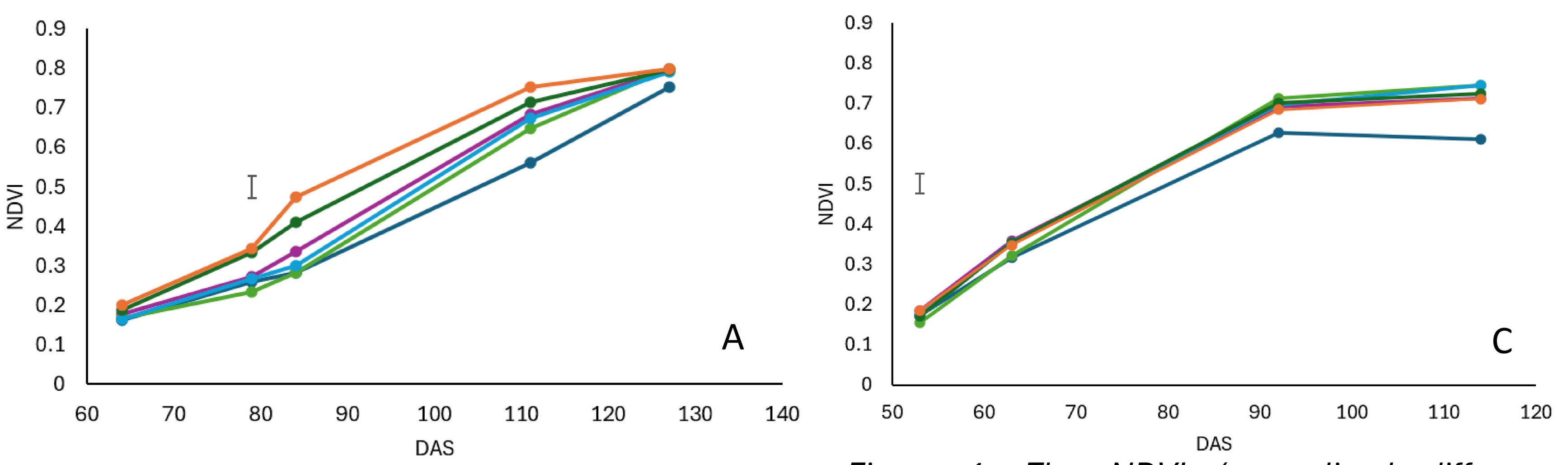
Replicated large plot trials were located at Morley (2024 & 2025) and Flempton (2024), in the East of England on sandy loam soils.
Plots were 12 rows wide and 10m long. Fertiliser was applied using a 3m tractor mounted spreader with fertiliser applied at drilling and around 14 days post emergence.

NDVI was assessed using a Holland Scientific Crop Circle system at frequent intervals until canopy closure. Biomass was assessed at three points in the season from 2m^2 digs with the last assessment at the same time as harvest. Harvest was undertaken with Garford harvester which lifted 3 rows the 10m length of the plot. AN impurities were measured from a sub sample of beet using polarimetry.

Treatments were as follows:

				Split 1		Split 2		
Treatment	Product	% N	Total N (kg ha)	Product rate (kg/ha)	N (kg ha)	Product rate (kg/ha)	N (kg/ha)	N total (kg/ha)
1 – Control	None	-	-	-	-	-	-	0
2 – AN50	AN	34.5	50	150	52	0	0	52
3 – AN100	AN	34.5	100	180	62	110	38	100
4 – Urea 100	Urea	46.0	100	130	60	90	40	100
5 – CCm	CCm	12.0	100	500	60	340	40	100
6 - OMF	OMF	10.0	100	600	60	400	40	100

Results



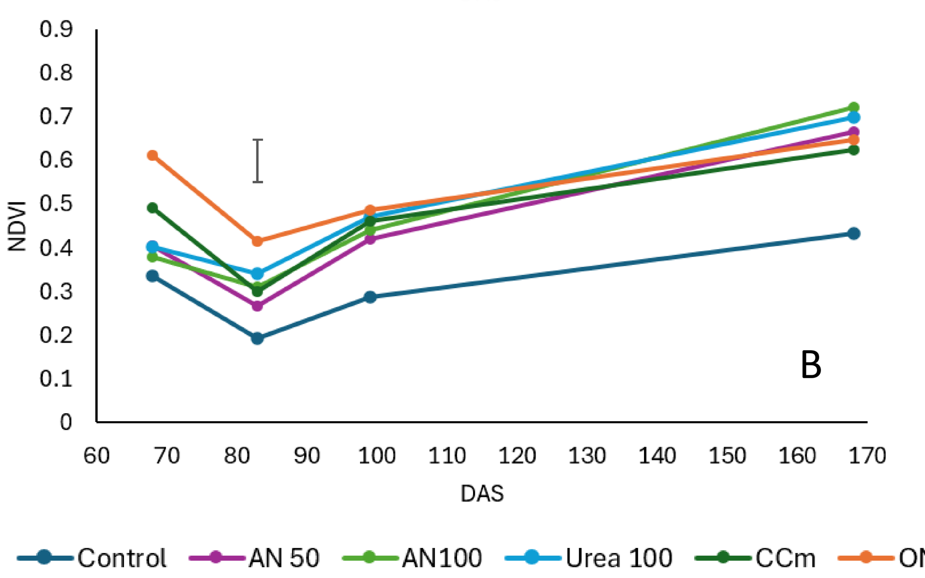


Figure 1. The NDVI (normalised difference vegetation index) of sugar beet grown after five different nitrogen fertiliser regimes and a non-fertilised control. DAS – Days after sowing.

Morley in Norfolk 2024 (A) and (B) 2025 and Flempton in Suffolk 2024 (C).

*(A) P<0.001, LSD=0.057, (B) P<0.001, LSD=0.097. (C) LSD=0.048, P=0.019. Error bars show time*treatment interaction.*

- By mid-June at Morley in 2024 (Fig. 1A) the CCm and OMF treatments produced significantly larger canopies than the other treatments (*P<0.001*), with OMF becoming significantly greater than CCm at the following measurement.
- At Flempton in 2024 (Fig. 1B), OMF plots had significantly higher NDVI early in the season (Fig 1B)
- By the final measurement in 2024 all treatments had similar canopy cover, indicating that CCm and OMF accelerated canopy development rather than increasing final canopy size.
- In 2025 at Morley (Fig. 3C) all fertiliser treatments performed similarly highlighting that there may be as seasonal interaction.

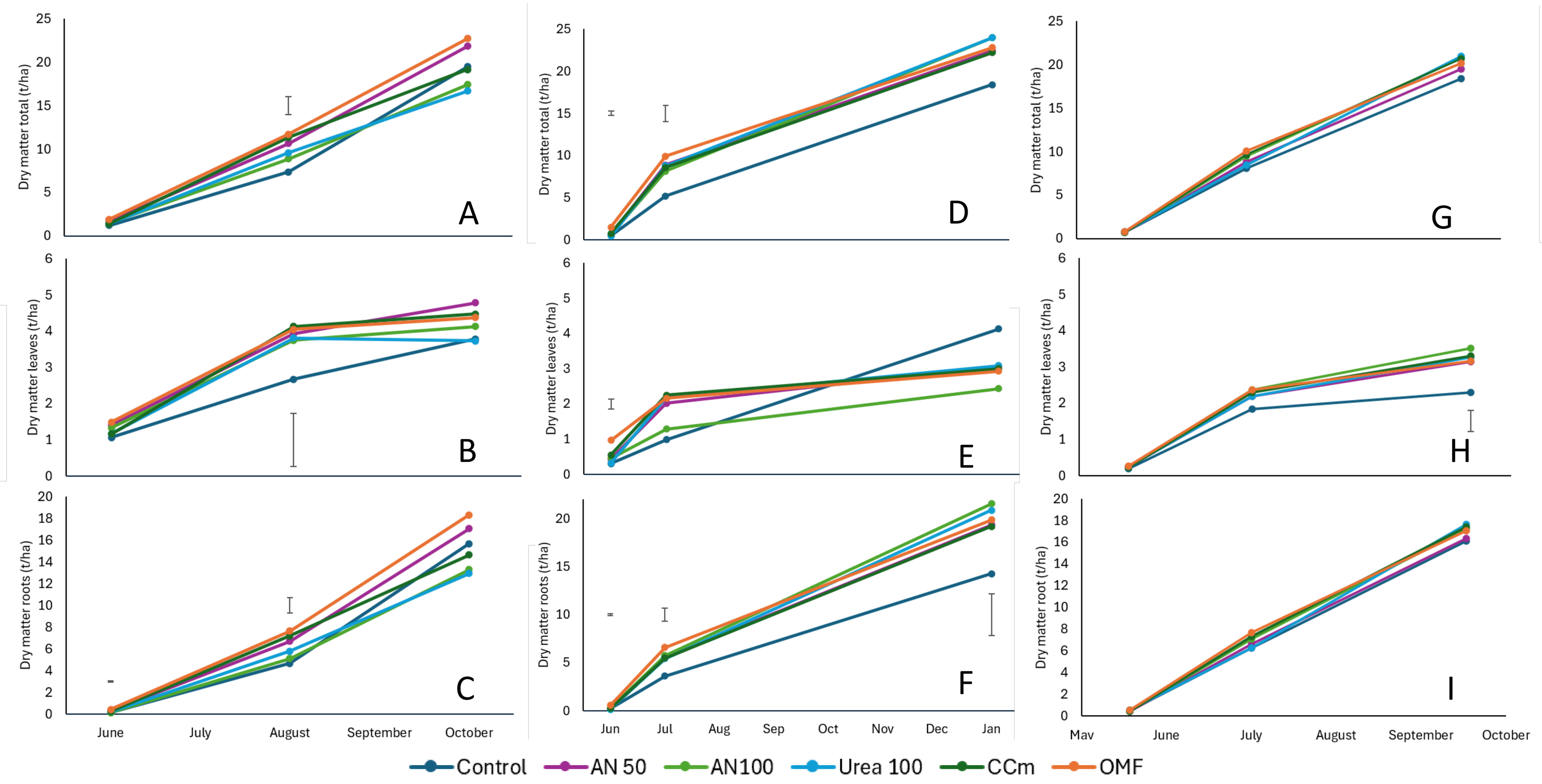


Figure 2. The total dry matter, leaf dry matter and root dry matter of sugar beet grown at Morley in 2024 (A, B, C), Flempton 2024 (D, E, F) and Morley 2025 (G, H, I) under five different nitrogen fertiliser regimes and a non-fertilised control. (A) August P=0.004, LSD=2.08. (B) August P = 0.008, LSD=0.73. (C) June P=0.005, LSD=0.15 and August P=0.002, LSD=1.41. (D) June P=0.004, LSD=0.49, July P=0.002, LSD=1.88. (E) June P=0.002, LSD=0.29. (F) June P=0.024, LSD=0.24, July P=0.009, LSD=1.34, January P=0.035, LSD=4.31. (G) n.s (H) October P=0.009, LSD=0.58 (I) n.s. Treatment LSD shown.

- At Morley in 2024 (Fig 2A) total dry matter was similar among treatments in June, but OMF had significantly greater root dry matter (Fig 2C, *P=0.004*). By August, CCm and OMF produced significantly higher total dry matter than the other treatments (*P=0.008*). The increased biomass was mainly due to greater root dry matter.
- At Flempton in 2024, OMF produced significantly greater total dry matter in June (fig 2D, *P<0.001*), due to higher root (Fig 2E, *P=0.024*) and leaf (Fig 2F, *P=0.002*) biomass.
- In 2025 at Morley there were few differences between treatments again suggesting a seasonal interaction (Fig 2G, H, I).

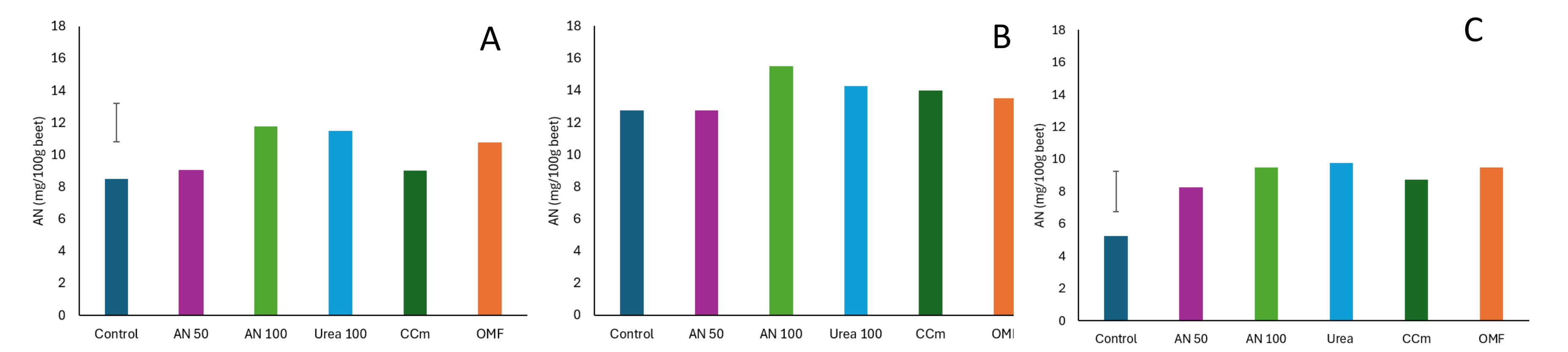


Figure 3. The amino nitrogen (AN) impurities of sugar beet roots grown at Morley in 2024 (A), Flempton 2024 (B) and Morley 2025 (C) under five different nitrogen fertiliser regimes and a non-fertilised control. (A) P=0.033. LSD=2.36. (b) n.s (C) P=0.013. LSD=2.47. Treatment LSD is shown.

- Amino nitrogen impurity levels were low across all sites and years.
- At Morley 2024 (Fig 3A), AN 100 and Urea 100 had significantly higher impurity levels than the control, AN 50 and CCm (*P=0.033*)
- At Flempton 2024 (Fig 3B), impurity levels did not differ significantly between treatments
- In 2025 at Morley (Fig 3C) all fertilised treatments had higher amino nitrogen levels than the control (P=0.013), again highlighting a seasonal interaction

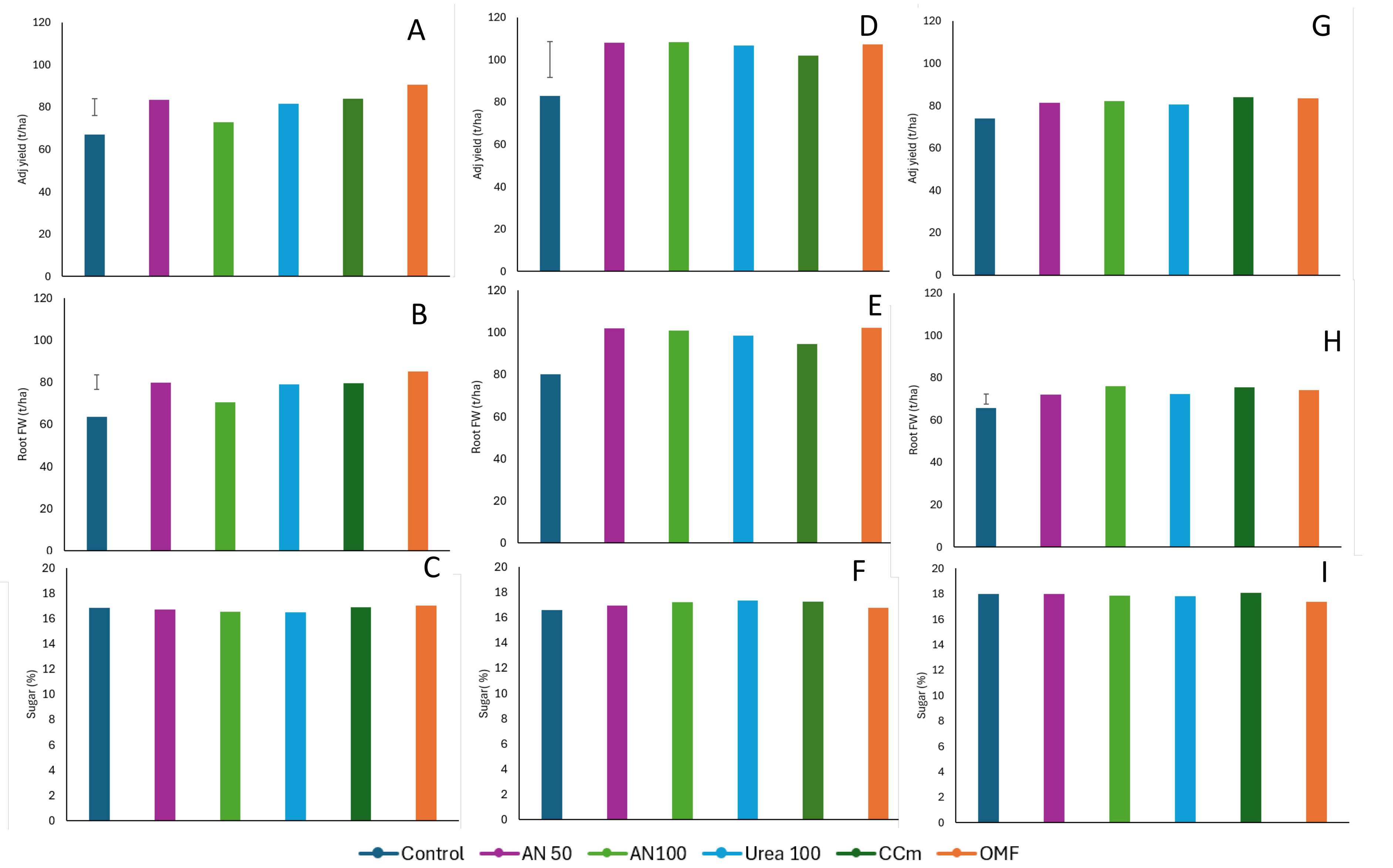


Figure 4. The adjusted yield, root fresh weight and root sugar % of sugar beet grown at Morley in 2024 (A, B, C), Flempton 2024 (D, E, F) and Morley 2025 (G, H, I) under five different nitrogen fertiliser regimes and a non-fertilised control. (A) P<0.001, LSD=7.80, (B) P<0.001. LSD=6.95. (C) n.s (D) P=0.040, LSD=16.81, (E) n.s (F) n.s (G) n.s (H) P=0.004. LSD=4.71. (I) n.s. Treatment LSD is shown.

- At Morley 2024 (Fig 4A), OMF produced a higher yield than the control and Urea 100 (*P<0.001*), while at Flempton (Fig 4D) and Morley 2025 (Fig 4G) the fertilised treatments yielded similarly
- At all site the differences were driven by root yield rather than sugar content
- The poor performance of AN 100 at Morley 2024 (Fig 4 A,B) is unexplained.

Summary

- Organo-mineral fertilisers perform as well as traditional mineral fertilisers in sugar beet crops
- In some cases, they outperform mineral fertiliser, but more research is needed to understand the conditions which drive this
- BBRO are conducting a third year of trials to explore this further

Acknowledgements: Thank you to Eleanor Towler for data collection and the wider BBRO team and host growers for making these trials possible

For more information visit the BBRO website: https://www.bbro.co.uk