Portsmouth Water AAN Trial Report – West Marden Farm

May 2025

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Portsmouth Water

Catchment Sensitive Farming
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Introduction

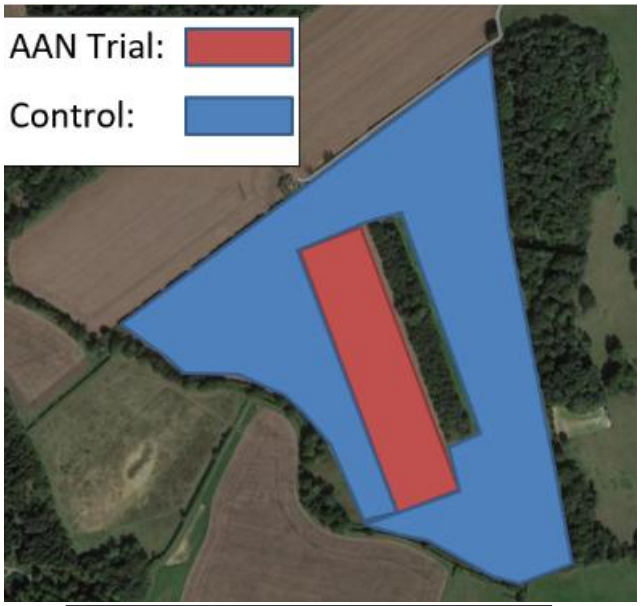
Portsmouth Water, and S. Woodley Crop services have collaborated with West Marden Farms to carry out a trial looking into the effectiveness of Additional Available Nitrogen (AAN) analysis between Autumn 2023 and Spring 2025. The planning of effective nutrient applications can reduce the risk of nutrients, particularly Nitrogen, from leaching into the water and wider environment. This is a high priority for Portsmouth water, East Hampshire and Western Streams catchment, as excess nutrients can cause eutrophication in aquatic habitats which is detrimental to the biodiversity that inhabits them. AAN testing is not widely encouraged by agronomists and therefore not commonly implemented into nutrient management planning as the exact science is yet to be established.

The prospect of investigating the impact of using Additional Available Nitrogen (AAN) as a tool to inform nutrient management planning is one to be encouraged. There is a lack of knowledge on the ground in using AAN to inform nitrogen inputs and if applied to a nutrient management plan, does it have the potential to save costs in inputs, and thus reduce the amount of nitrogen being applied in the catchment?

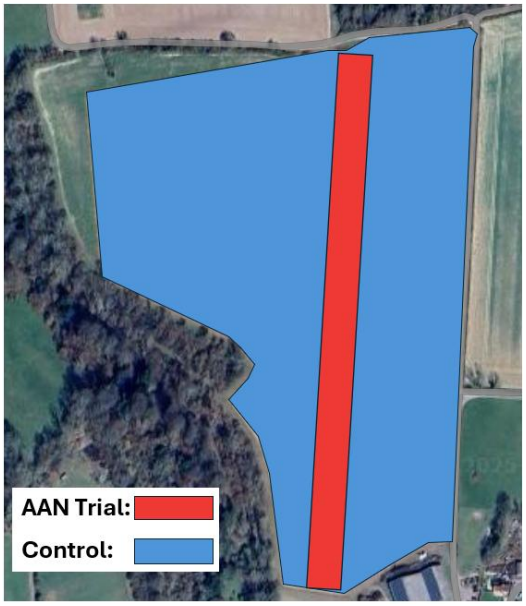
The Trial

The aim of this trial was to provide a case study for the benefits of taking AAN, alongside Soil Mineral Nitrogen (SMN) testing into consideration when nutrient management planning. The yield of the following cash crop was then assessed to see if AAN is a viable and practical measure in nutrient planning.

One of the main concerns to growers regarding the AAN testing is the cost, Portsmouth Water and Natural England have agreed to cover the costs of the trial crop.



Map showing the trial field and areas for harvest 2023



Map showing the trial field and areas for harvest 2024.

Proposed Nutrient applications on the trial plots

Table 1: Proposed nutrient applications on the trial plots 2023:

AAN Trial **Total N: 190kgN/ha**	Normal Fertiliser Regime **Total N: 210kg N/ha**
SNS index 2 (using the 87kg/ha N in the soil from AAN sample)	SNS Index 0 (AAN SNS index 2) disregarded in the fertiliser program
70kgN/ha **200L / ha** of NS35 Liquid fertiliser early March.	70kgN/ha **200L / ha** of NS35 Liquid fertiliser early March.
50kgN/ha **140L / ha** of NS35 Liquid fertiliser April.	60kgN/ha **200L / ha** of NS35 Liquid fertiliser April.
70kgN/ha **200L / ha** of NS35 Liquid fertiliser Early May.	80kgN/ha **230L / ha** of NS35 Liquid fertiliser Early May.

Table 2: Proposed nutrient applications on the trial plots 2024:

AAN Trial **Total N: 190kgN/ha**	Normal Fertiliser Regime **Total N: 230kg N/ha**
SNS index 2 (using the 64kg/ha N in the soil from AAN sample	SNS Index 0 (AAN SNS index 2) disregarded in the fertiliser program
70kgN/ha 175L/ha of N30 + 10So3 Late February	70kgN/ha 175L/ha of N30 + 10So3 Late February
60kgN/ha 200L/ha of N30 + 10So3 Late March	80kgN/ha 200L/ha of N30 + 10So3 Late March
60kgN/ha 200L/ha of N30 + 10So3 Early May	80kgN/ha 200L/ha of N30 + 10So3 Early May

Methodology

Soil Sampling:

Soil mineral nitrogen sampling was carried out in February prior to any organic manure applications to set a baseline of nitrate levels within the soil. SMN samples were repeated after harvest and again in late February each year.

Visual Differences:

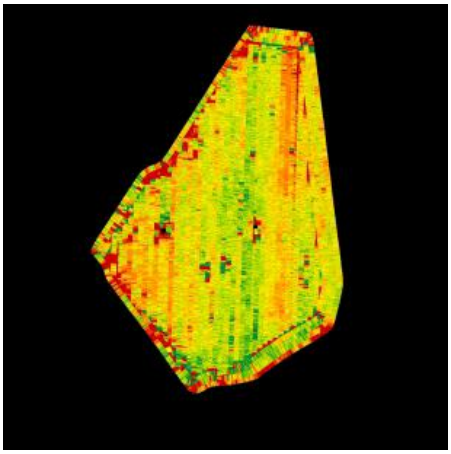
Site visits were made throughout the growing season to determine any differences in wheat growth.

Tissue Samples:

Tissue samples were taken each month March-June to measure any potential nutrition deficiencies in the plants.

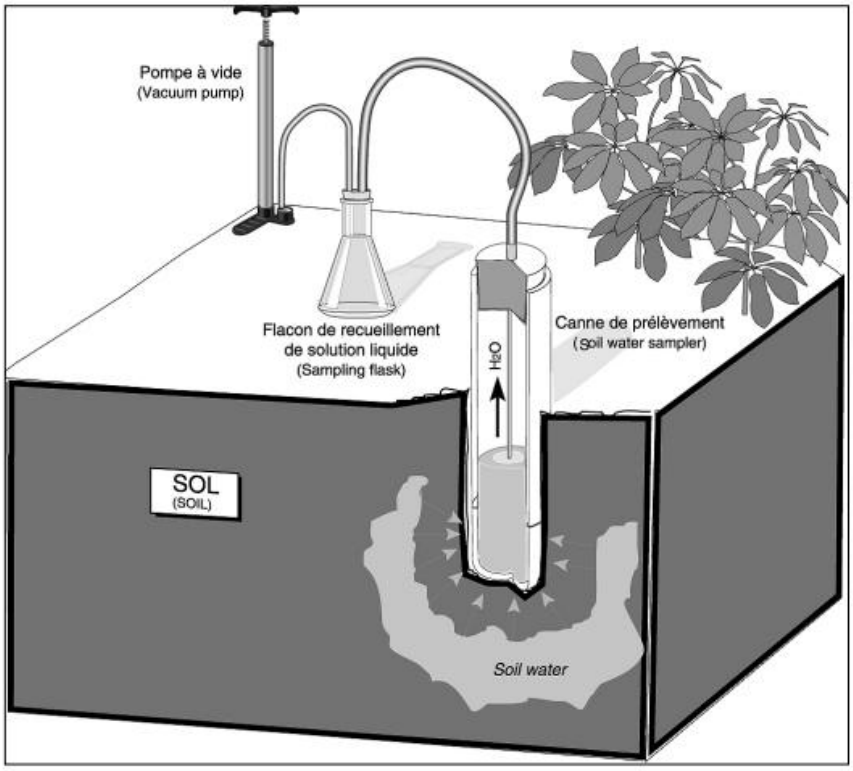
Yield and Grain Analysis:

Yield data gathered at the point of harvest and grain analysed for protein content.



Porous Pots:

Twelve porous pots were installed in each treatment, giving a total of twenty two porous pots across the trial. Porous pots were sampled once every two weeks from the beginning of November through to the end of February. The water samples gathered from the porous pots were analysed as fresh samples for nitrate levels (mg/l) which provided an excellent indication of the potential nitrate leaching through the soil profile.



Results Summary

Table 3: SMN (Soil Mineral Nitrogen) Results 2023-2024:

Field Reference	Feb 2023 SMN kgN/ha	August 2023 SMN (kgN/ha)	Feb 2024 SMN kgN/ha)
AAN Trial	27.8	59	93
Control	25.5	63	91
Average	**26.65**	**61**	**92**

The results from the SMN sampling show that the nitrogen content in the soil is very similar between the trial and the control throughout the season, despite the additional 30kg/ha added to the control.

Table 4: SMN (Soil Mineral Nitrogen) Results 2024-2025:

Field Reference	Feb 2024 SMN kgN/ha	August 2024 SMN (kgN/ha)	Feb 2025 SMN kgN/ha)
AAN Trial	93	67	62
Control	91	61	47
Average	**92**	**64**	**54.5**

Results from the SMN sampling show that the nitrogen content in the soil remains similar through spring 2024 and summer the same year. By the time we reach Spring 2025, the results are quite different with an additional 15kg/ha of nitrogen in the Trial, going against the expectation given the reduced N applications.

The results from the SMN sampling over both years show that on average the trial has performed similarly to the control. This suggests that considering AAN when planning nutrient management could help to reduce costs and environmental impacts. These results however do not reflect yield data which needs to be factored in.

Table 5: Tissue Sample Results 2023:

Sample	Average N Content in plant	Average N Content in plant	Average N Content in plant	Combined Average
	N:S Ratio % **03/05/2023**	N:S Ratio % **25/05/2023**	N:S Ratio % **14/06/2023**	N:S Ratio %
Control 1	2.3	1.69	1.07	1.68
Control 2	2.87	1.65	1.1	1.87
Trial 1	2.16	1.73	1.26	1.71
Trial 2	2	1.5	0.97	1.49

With the additional Nitrogen added, the results of the tissue sampling should have been higher in the control. However, that is not supported with the data gathered throughout the season, with no statistical differences between the results. The results above show that the plant has the equal opportunity to growing successfully.

Table 6: Tissue Sample Results 2024:

Sample	Average N Content in plant	Average N Content in plant	Combined Average
	N:S Ratio % 18/04/2024	N:S Ratio % **16/05/2024**	N:S Ratio %
Control	3.78	2.3	3.04
Trial 1	3.49	1.65	2.57

The results from the tissue sampling in 2024 show that the higher nitrogen rate in the control has benefited the plant growth. This suggests that the plants in the control have a better opportunity to reach their potential. The other data gathered through the season shows varied results in support or against the use of AAN as part of a management plan.

The results from both years of the trial have different outcomes for tissue sample results and could reflect varying soil types across the fields, varying weather conditions or the varying nitrogen applications.

Table 7: Grain and yield analysis results 2023:

Field Reference	Protein (%)	haG	Kg/hl	Moisture (%)	Gluten	Yield t/ha
AAN Trial	9.85	105	71	16.27	15.18	9.74
Control	10.39	140	71	15.83	16.65	9.1

The grain analysis results show that the protein has yielded just under half a percent higher for the control with the kg/hl being the same due to an increased moisture content in the trial area. The protein yield has been significantly benefited by the additional 30kg/ha of nitrogen. This Typhoon wheat is being grown for feed; therefore, the farm will not receive any additional income from this higher protein figure.

In terms of yield, there is a 0.64t/ha difference between the trial area and the rest of the field average. Although this does not sound like much of a difference, in real terms this equates to over £70/ha more revenue.

Table 8: Grain and yield analysis results 2024:

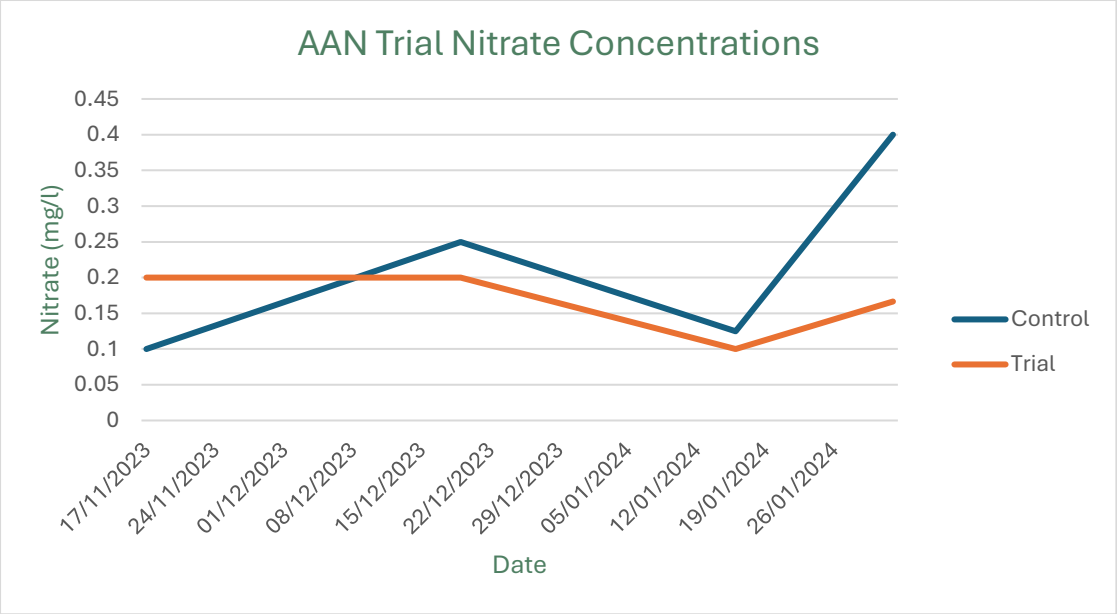
Field Reference	Protein (%)	Kg/hl	Moisture (%)	Yield t/ha
AAN Trial	7.76	71.5	14.56	11.0
Control	8.63	74	14.28	11.4

The grain analysis results show that the trial has produced a grain with 0.87% less protein. This difference is supported by the tissue sampling, which showed less nitrogen in the plant tissue throughout the trial and during key growth stages. In terms of yield there is a 0.4t/ha difference between the control and the trial. Across an entire field or farm this would significantly impact the total revenue.

Table 9: Porous Pot Results Nov 2023 – Feb 2024:

Control		Trial	
Date of Sample	Nitrate (mg/L)	Date of Sample	Nitrate (mg/L)
17/11/2023	**0.1**	17/11/2023	**0.2**
19/12/2023	**0.25**	19/12/2023	**0.2**
16/01/2024	**0.125**	16/01/2024	**0.1**
01/02/2024	**0.4**	01/02/2024	**0.16**

Figure 1. Graph showing porous pot results 2023-2024

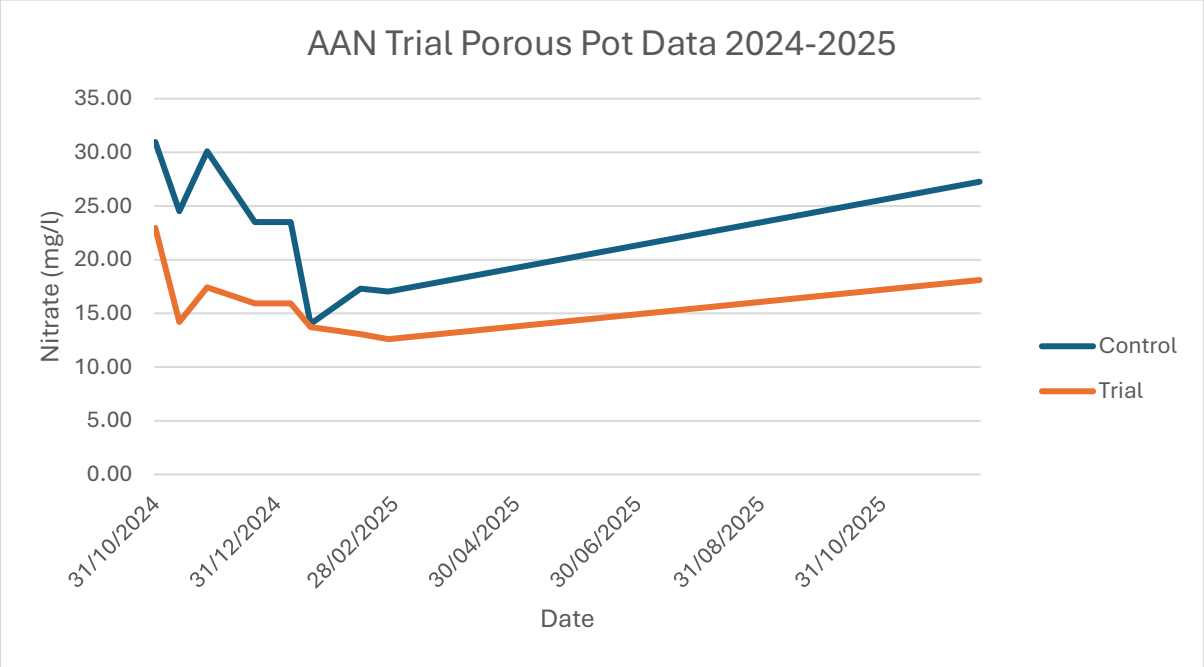


Apart from a spike in the last round of data collection, the results from the porous pot data in both the trial and the control are very similar. These readings are all low and under 1mg/l. This suggests that the Nitrogen being added to the field is being used efficiently by the crop and the subsequent cover crop. The difference is not significant enough to make a big difference to the overall concentration of nitrate getting into the aquifer.

Table 10: Porous Pot Results Nov 2024 – Feb 2025:

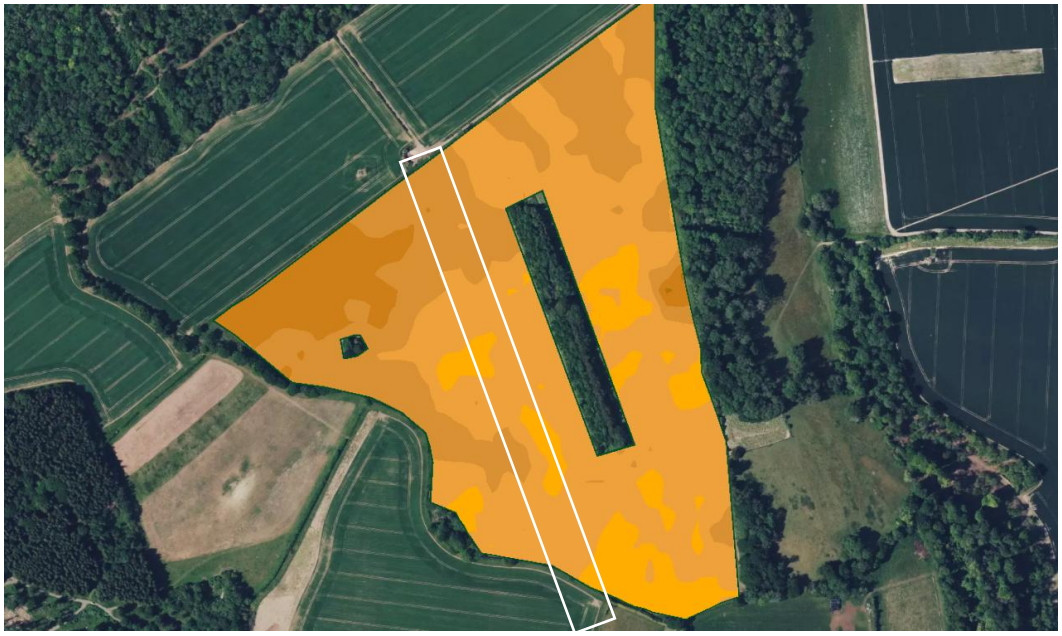
Control		Trial	
Date of Sample	Nitrate (mg/L)	Date of Sample	Nitrate (mg/L)
31/10/2024	**30.97**	**31/10/2024**	**22.96**
12/11/2024	**24.53**	**12/11/2024**	**14.22**
26/11/2024	**30.10**	**26/11/2024**	**17.42**
19/12/2024	**27.25**	**19/12/2024**	**18.10**
20/12/2024	**23.50**	**20/12/2024**	**15.93**
07/01/2025	**23.50**	**07/01/2025**	**15.93**
17/01/2025	**14.02**	**17/01/2025**	**13.72**
11/02/2025	**17.30**	**11/02/2025**	**13.06**
25/02/2025	**17.05**	**25/02/2025**	**12.60**

Figure 2. Graph showing porous pot results 2024-2025

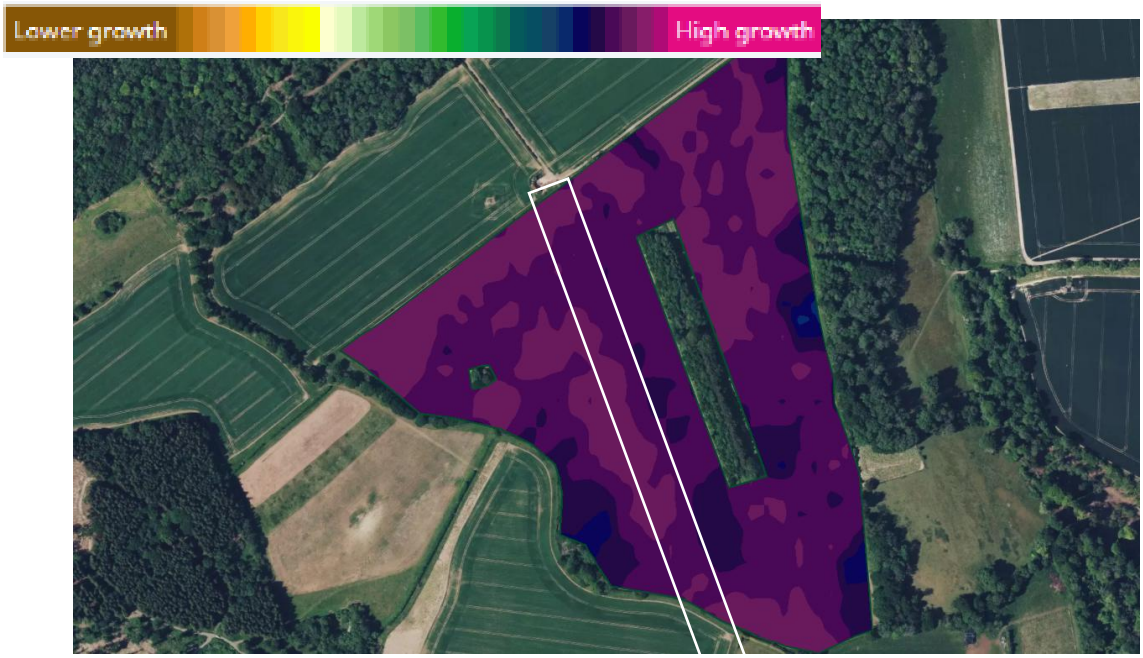


The results from the ground water monitoring in 2024-2025 show that the trial has a reduced level of nitrogen throughout the trial period. This suggests that applying nitrogen and accounting for the AAN has reduced the nitrogen leaching in the field.

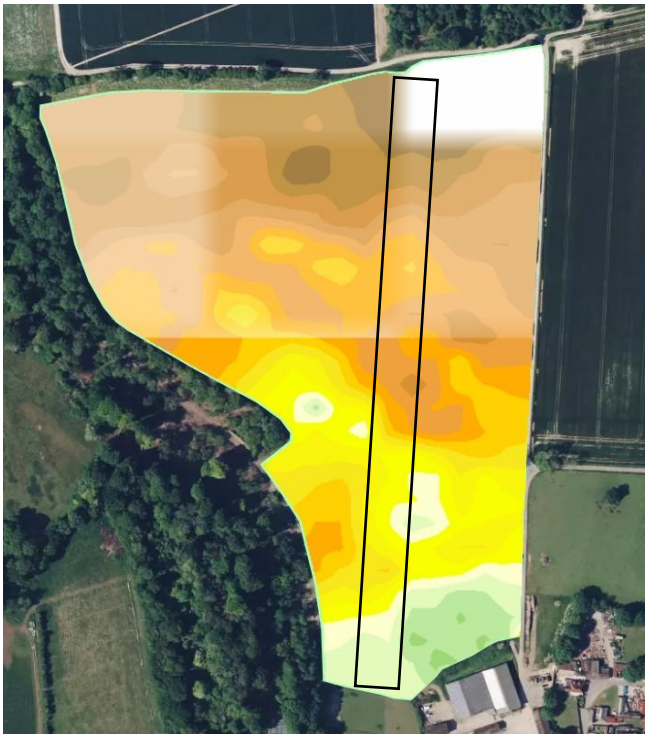
When comparing the data from both trial seasons, there is a significant difference in the amount of nitrogen leaching which is being measured by the porous pots. This could be due to the difference in topography of the fields chosen or the varying soil types between the fields. The biggest difference in trial and control can be seen in 2024 where the trial has significantly reduced the amount of nitrogen tested in the porous pots.



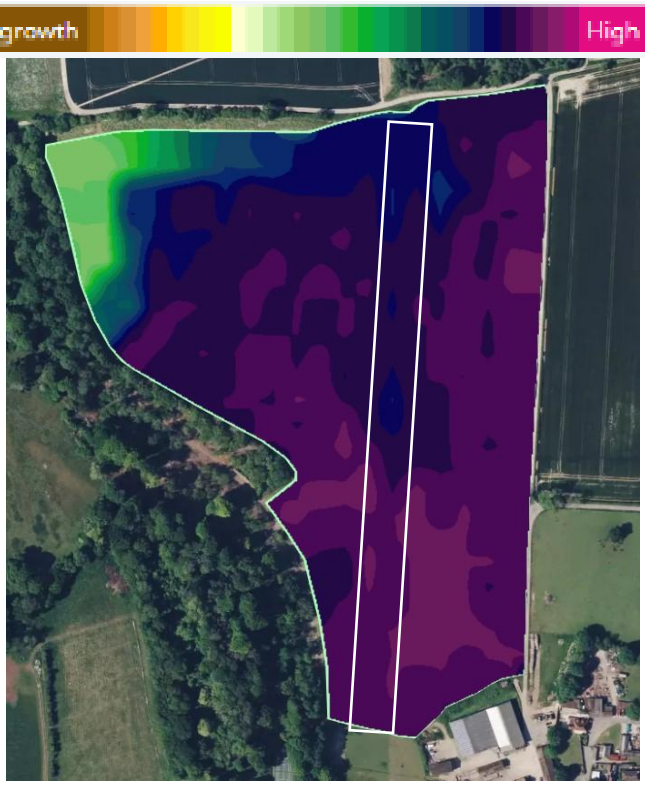
Satellite image captured on 02/03/2023, showing the variability in growth rates across the trial field. White rectangle indicates the AAN Trial area. The rest of the field serves as a control. There is no clear difference in this image between the trial and the control, indicating that at this point, the trial and control and showing a similar growth rate. The variability is likely the result of differences in the makeup of the soil.



Satellite image captured on 26/05/2023, showing the variable growth rates across the trial field. White rectangle indicates the AAN Trial area. The rest of the field serves as a control. From the image, there is no clear difference between the trial and the control as there are patches throughout the field that have the same growth. The trial is also next to a wooded dell that will cast shade during the first part of the morning. This could explain some of the darker shading (higher growth) compared to other parts of the field.



A satellite image, taken on 01/03/2024, illustrates the varying growth rates across the field. The trial area is outlined by a black rectangle. At this stage of growth, there is no observable difference in growth between the trial area and the control (the remainder of the field).



A satellite image taken on 25/05/2024, shows that the variance in growth across the field is no greater in the trial area than in the control. This shows that at this stage the trial area is performing similarly to the control.

Table 11: Results Summary 2023

Plot	Trial	Control
Treatment	AAN result	Farm standard
Total N applied (kg N/ha)	190	220
Nitrogen use efficiency* (%)	47	44
Yield (t/ha)	9.1	9.74
Protein Content (%)	9.85	10.39
Gross margin incl fert costs** (£/ha)	£1,462	£1,532
Difference between spring & autumn SMN results (kg available N/ha)	31.2	37.5

Nitrogen use efficiency = kg grain/ha divided by kg N applied/ha

****** Based on grain price of £200/t and market fertiliser price of £650/t***

Note that the cost of an AAN sampling and analysis package is £180 per field.

Table 12: Results Summary 2024

Plot number	Trial	Control
Treatment	AAN result	Farm standard
Total N applied (kg N/ha)	190	230
Nitrogen use efficiency* (%)	58	50
Yield (t/ha)	11.0	11.4
Protein Content (%)	7.76	8.63
Gross margin incl fert costs** (£/ha)	£2076.5	£2150
Difference between spring & autumn SMN results (kg available N/ha)	6	14

Nitrogen use efficiency = kg grain/ha divided by kg N applied/ha

****** Based on grain price of £200/t and market fertiliser price of £650/t***

Note that the cost of an AAN sampling and analysis package is £180 per field. Prices were kept the same for comparison but have changed since the beginning of the trial.

Conclusion

The trial results indicate that, in both years, the farmer would have experienced a financial loss by adopting the AAN method. Despite reduced nitrogen applications, the lower yield would still have left them out of pocket. When the costs of sampling and analysis are factored in, it becomes evident that the AAN method is not financially viable.

That said, the crop has performed reasonably well, with an impressive 11t/ha yield in 2024, despite the lower nitrogen input. While the environmental benefits of reduced

nitrogen application seem logical, the data from both years does not clearly support this assumption. Multiple factors—including weather conditions, crop variety, available nutrients, and soil type—all contribute to the nitrogen use and leaching, making farming more of an art than a precise science.

If the baseline SMN sampling influenced the first application and subsequent applications were calculated based on regular tissue sampling and perhaps N-tester surveys, this might reduce the farmers worry in applying less nitrogen and potentially reducing the yield.