Title: WW23-9513 Saxmundham Experimental Site Report 2023.

Trial Code: WW23-9513
Centre: Morley
Crop: Winter Wheat
Variety: Gleam
Report Author: David Clarke

Objective:

To measure and compare the response to crop and soil from the application of granular and foliar phosphate and potassium-based mineral fertilisers, manures and organic amendments.

Background:

The Saxmundham Experimental site was started in 1899 and has been managed by various organisations since this time including Rothamsted Research. The site is currently supported through TMAF and the NIAB Morley Long Term Studies (LoTS) initiative. Despite falling out of service in recent years, through the intervention of TMAF, NIAB and local farmers, the long-term experimental work has been resurrected. In 2020 some treatments were introduced to better reflect modern phosphorus management and challenges the industry faces. The trial studies the effects of cumulative application of P and/or K fertilisers (granular and foliar) compared to farmyard manure (FYM) and green waste compost (GWC). The full treatment list and research rationale are reported in Table 1. The rotation is based ostensibly on combinable cropping (Table 2). All nitrogen and pesticide inputs are of standard farm practice. Each plot is approximately 40m x 5.5m with four blocks (reps), although treatments are not randomised in each block.

Summary:

In 2023, the Saxmundham site was sown with winter wheat on 21st September 2022 at 150 kg/ha following the incorporation of annual additions of fertiliser, manure, or amendments as per treatment.

Soil P levels are all around experimental targets ranging from Index 3 to Index 0 at the treatment level.

Soil K has a smaller variance due to the naturally K-releasing soils, ranging from index 2+ to 2- at the treatment level.

Soil organic matter is 0.6-0.8% higher in plots receiving FYM. The GWC plots appear to be responding to additions with a soil organic matter 0.2%-0.4% higher than plots not receiving any organic amendments or manure.

Due to black-grass pressures, the winter wheat crop was spot-sprayed out. While yield data was obtained it appeared to be impacted by the large areas of the plots sprayed out and therefore is not reported.

The 2024 season will be a fallow year in an attempt to manage blackgrass pressures.

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Treatments:

Table 1: Treatment list with description and rationale, new treatments for the 2020-2025 trial programme are highlighted *

Treatment (Label)	Details	Rationale
Untreated (Unt)	No organic or in-organic P or K fertiliser	Untreated control
Cattle FYM (FYM)	Annual applications (25 t ha) of farmyard manure. Have been applied for a large proportion of the 120 year trial	Comparing organic P and K sources to mineral fertiliser
Green waste compost + P_2O_5 (GWC)*	Dose to match organic matter returns from 25 t/ha FYM Soil P maintained at index 1 (P_2O_5 dose adjusted for P in compost) Soil K maintained at index 2 (K_2O dose adjusted for K in compost)	By improving soil structure through amendment use can yields be maintained on a P index 1 soil compared to standard (PK) nutrient management?
Folex P (Foliar)*	Repeated foliar applied P treatments (4 in 2021) Folex P supplied by OMEX (14%N, 46% P2O5 w/v) applied at 15 l/ha	With a P index 0 soil how much of a crop's phosphate demand can be met through foliar sprays?
P_2O_5 (P)	RB209 recommended dose based on soil P analysis (2019) and estimated offtake	Crop response to optimal applications of P mineral fertiliser only
K_2O (K)	RB209 recommended dose based on soil K analysis (2019) and estimated off-take	Crop response to optimal applications of K mineral fertiliser only
$P_2O_5 + K_2O$ (PK)	RB209 recommended dose based on soil P and K analysis (2019) and estimated off-take	Crop response to optimal applications of P and K mineral fertiliser
$P_2O_5 + K_2O$ (P_LK)*	RB209 recommended dose for maintaining P at Index 1 and K at Index 2 based on soil analysis	Crop response to optimal K and low P fertiliser applications. Direct comparison for GWC treatment

Table 2: Crop rotation.

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Crop	1st WW	2nd WW	W Barley	1st WW	WOSR	1st WW	SW	W Barley	W Beans	1st WW

Results

Soil properties

Soil P concentrations (Figure 1) are in line with the experimental targets (Table 1). The FYM, P, and PK plots are at a low index 3, indicating that crops should have an adequate soil P supply. The GWC and PLK plots have responded to fresh P applications (both inorganic and organic) since treatment updates in 2019. These plots are now at a low index 2, and efforts will be made to maintain them at an index 1. There are signs that the regular addition of foliar-applied P is increasing the soil P levels in the foliar plots. The K plots have also shown an apparent increase in soil P levels compared to untreated plots, despite not receiving any P applications. This is likely due to temporal sampling variation and will be monitored in the coming years. As expected, the untreated plot remains at an index 0, consistent with a soil that has not received any P additions since 1899.

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Figure 1: Average soil phosphate concentrations (Olsen's sodium bicarbonate extracted) mg/l across all treatments. Red vertical dashed line represents the updating of treatments in 2019.

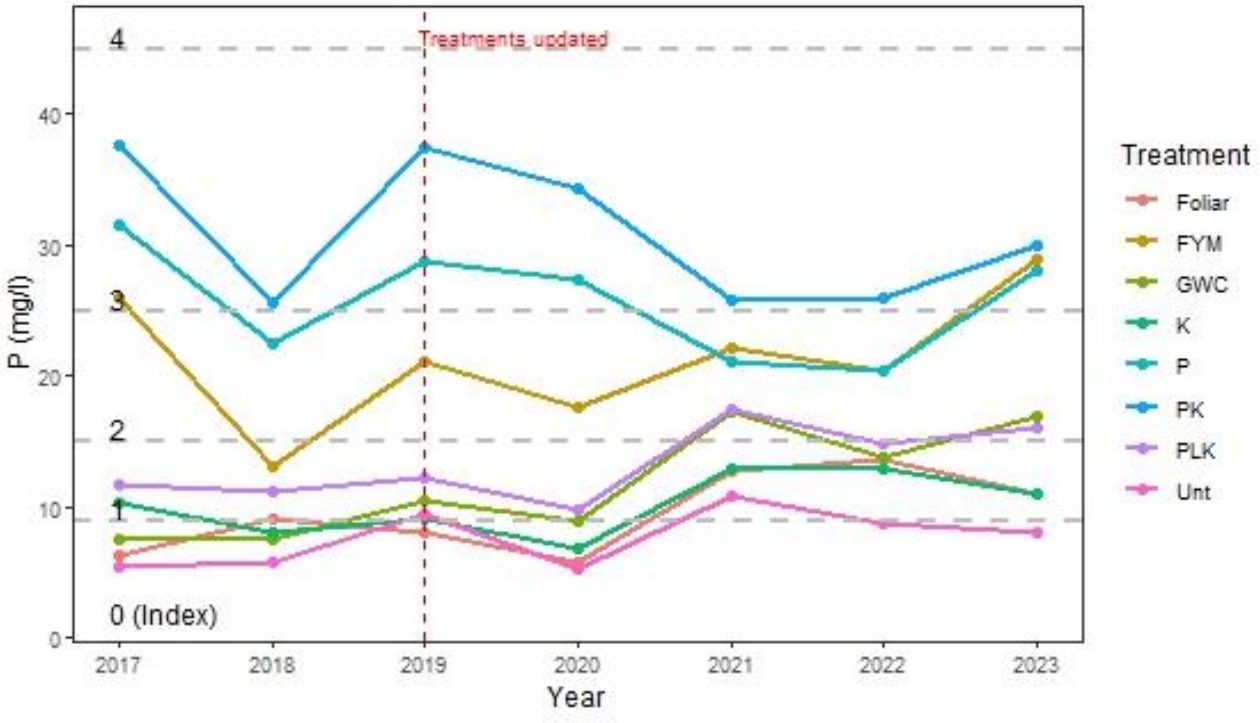
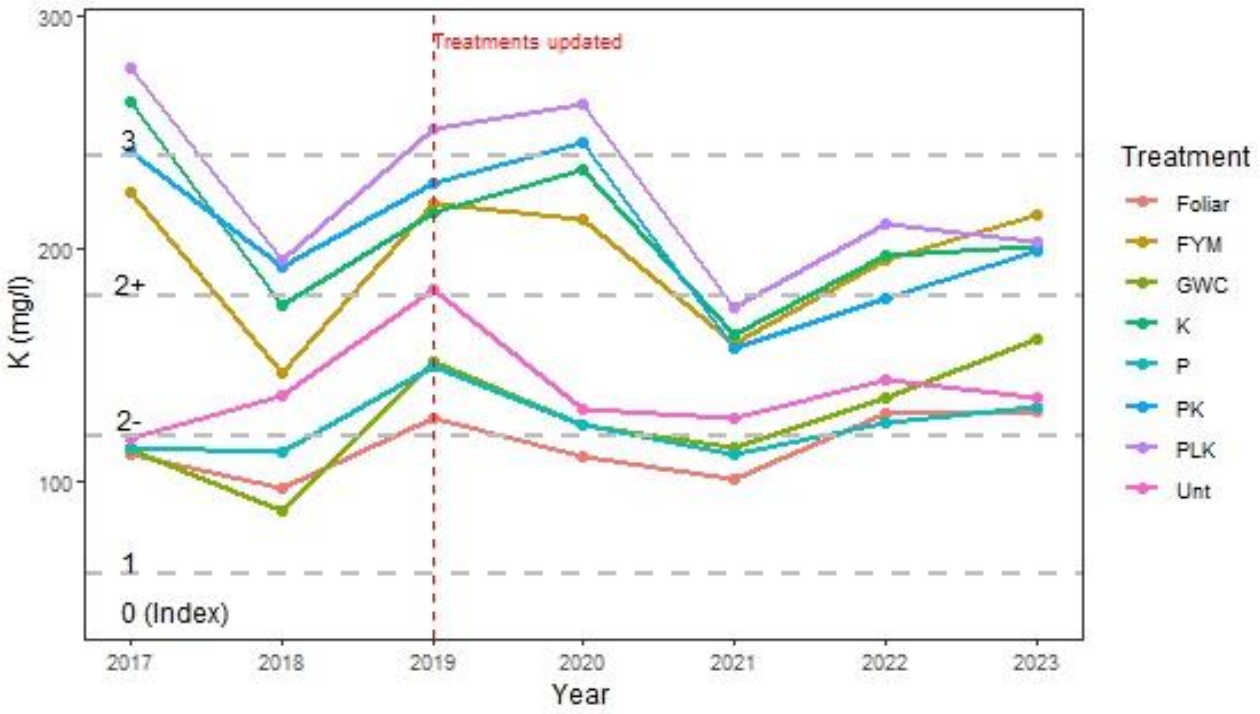


Figure 2: Average soil potassium concentrations (mg/l) across all treatments. Red vertical dashed line represents the updating of treatments in 2019.



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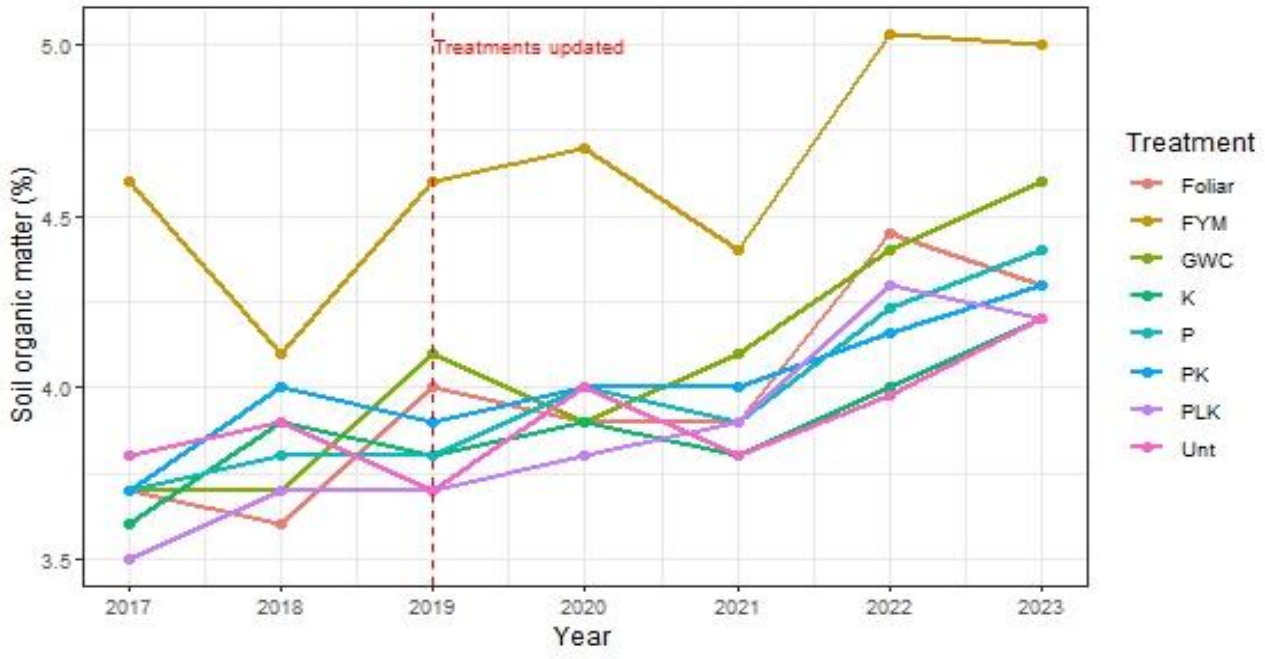
Treatments receiving historic potassium (K) additions, either from organic sources (FYM) or inorganic sources (PK, K, PLK), are at index 2+ levels, as intended by the research rationale. In contrast, treatments that have not received any K additions (Untreated, P) are at low index 2- levels. The response of the GWC and foliar plots to fresh K additions has been slow. However, there are initial signs of a response in the GWC plots. These plots will continue to be monitored, and K_2O will be applied at rates recommended to achieve the target indices. The soils at Saxmundham naturally release potassium, primarily from components found in finer particles such as vermiculite and mectite (Goulding and Talibudeen, 1979). Therefore, we do not observe the same treatment variation in K as we do in P. Crop response to K has historically been small compared to P.

Figure 2: Average soil organic matter concentrations (%) determined through loss on ignition, sample depth 0-15cm. Red vertical dashed line represents the updating of treatments in 2019



Soil organic matter (Figure 3) measured using loss on ignition shows the FYM plots with the highest soil organic matter of 5.0% in 2023. There are indications in 2023 that the annual applications of GWC since 2019 are starting to increase soil organic matter levels (4.6% in 2023) compared to treatments not receiving any organic amendments. Plots not receiving any amendments ranged from 4.2-4.4% (PK, K, P, Unt, Foliar). The FYM plots are only 0.6-0.8% higher in soil organic matter than PK plots, however, it is important to put this into context. This is as much as a 19% relative increase. All plots appear to be increasing soil organic matter levels since the site was reestablished in 2017. This trend is difficult to explain, as it is also present in plots not receiving any organic manure or amendments. This could be down to several factors including; although the site is not under any specific form of tillage practice, it is not routinely ploughed annually. It could be that reducing the frequency of ploughing is causing a greater concentration of organic material in the sampled depth (0-15cm). The residues are currently incorporated, while it's unsure what the history prior to 2017 was it could be that the incorporation of residues that were previously removed is adjusting the soil's equilibrium.

Crop performance

A large amount of black-grass (*Alopecurus myosuroides)* established in the 2023 wheat crop. A top cut and collect weed collector was used on the trial area when the blackgrass was in ear in an attempt to remove as much seed as possible. While achieving some removal there was still a large population in ear and it was decided that the remaining populations were terminated with glyphosate to preserve the long-term sustainability of the experiment (Figure 4). With the challenging conditions in spring 2024, it was decided instead of attempting to establish a spring crop the trial site was left fallow to control the existing blackgrass populations. It is planned the site will be drilled with winter wheat in autumn 2024.

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Figure 3: Aerial image of the trial site (red box) in June 2023. The large areas of sprayed-out crop are visible.

Appendix

Field details

Trial Code	WW23-9513
Trial Centre	Morley
Trial Location	Saxmundham
Crop	Winter wheat
Previous Crop	Winter beans
Soil Texture	Clay loam
Soil Series	Beccles/Ragdale series
Soil Analysis	As per treatment
Soil Mineral Nitrogen	N/A
Total N/ha applied	Varies with treatment
Drill Date	21/09/22
Seed Rate	150 kg/ha
Drilled Plot Dimensions	40m x 5.5m (farm crop)
Replicates	4 (not randomised)
Harvest Date	04/09/23

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