POTASH NEWS

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2021/22 Season Review

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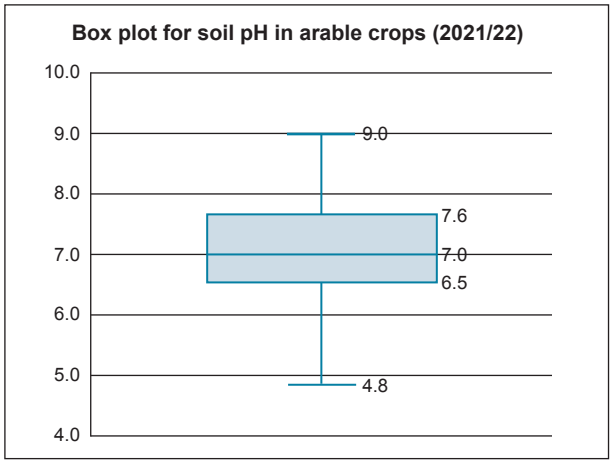
NRM is the UK's largest provider of agronomic analysis for land-based industries for improved farm productivity.

Looking back at last season with robust soil and crop analysis data is a fantastic means of assessing how the season went and determining how to improve performance for the coming season with insightful management decisions. As the UK's leading provider of agronomic analysis, NRM analyses thousands of samples from farms across the country each year. Regular soil testing has always been a part of good farm practice and was recently included as legislation in the Farming Rules for Water. Taking this further and analysing soils in conjunction with plant tissue, harvested crops, and inputs, can help farmers and their advisors to better understand their nutrient status and benchmark against other farms.



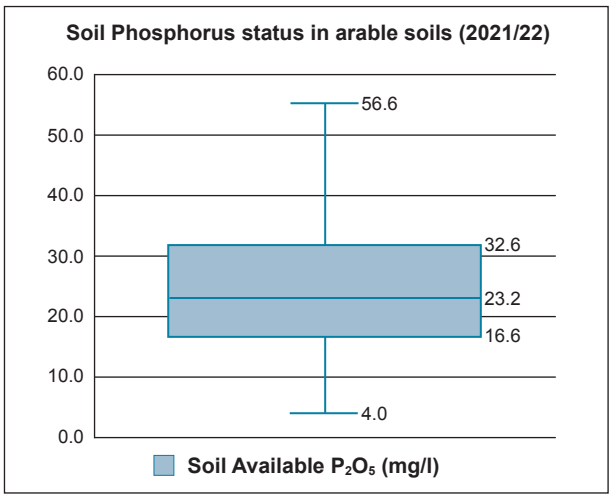
When it comes to soil nutrient analysis, the starting point must be to understand the pH of the soil. Incorrect soil pH can have a big impact on nutrient availability, particularly phosphate, however it is surprising how many soils still show up as being too acidic and in need of rectifying. In 2021/22, the samples analysed by NRM showed that soils ranged from pH 4.8 right up to pH 9, although the median of all results was close to pH 7. 25% of soils were below the optimum of 6.5 for arable soils and therefore in need of lime.

The Professional Agricultural Analysis Group (PAAG) data has regularly shown the proportion of UK soils that fall below the target levels for phosphate and potash, and NRM's data from last season is no different. For phosphate, whilst the median result came in at the top of index 2 (23.2mg/l), the spread ranged from just 4mg/l (low index 0) right up to 56.6mg/l (index 4). However, nearly a quarter of samples came in below an index 2 and therefore below the target for optimal uptake by arable crops and grassland.

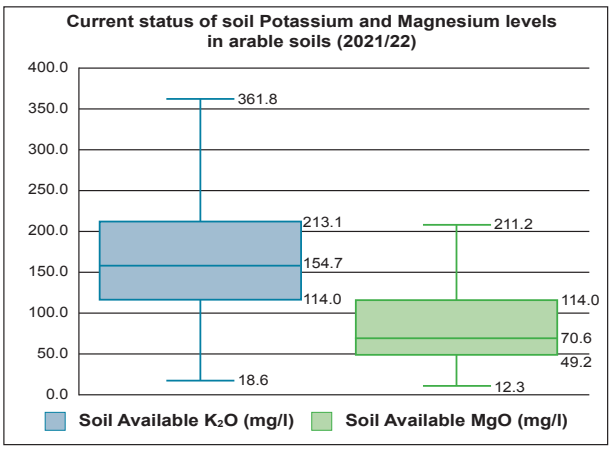
It should also be highlighted that nearly 40% came in at index 3 or above which could be because of an increased uptake of sewage sludge and digestate. Whilst there is no economic benefit from a higher phosphate index than 2 (unless vegetables are in the rotation), this could have implications on the environment.

As with phosphate, the potash samples showed that the median result was at the target level of index 2- (154.7mg/l). However, unlike the P samples, a greater proportion were measured at, or below, index 1 (29%) and therefore at risk of potassium deficiency. This could reduce crops' yield potential, especially with the recent history of dry weather patterns throughout spring and summer.

For magnesium, the median value was 2, which is the target level, and although 27% of samples were measured above the target index, there were still nearly a quarter of the results that were at index 1 or below which would benefit from magnesium applications for most crops.



These soil trends back up and reconfirm the annual position that has been highlighted each year through the PAAG (of which NRM is a member). This is not surprising, especially last season, considering the large increase in the cost of fertiliser (if not purchased in advance of last spring). More concerning could be the results of future soil samples, where applications may have been reduced or omitted.



Data from Grain Analysis

Soil analysis is one piece of the puzzle but is not the only measure that is worth considering. The basic principles of P&K nutrition in the UK revolve around ensuring that the soils contain sufficient nutrient (and the correct pH to ensure optimal availability of these nutrients) to provide crops with adequate daily quantities through the season to meet the peak uptake requirements. Although this is the theory, every soil will work slightly differently, and no two seasons are the same. Just because a soil is at the target index, does not necessarily mean it is able to access sufficient quantities due to variables such as:

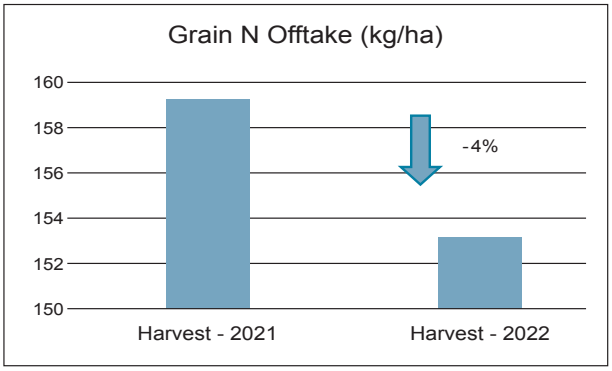
- Soil characteristics (texture, moisture content, temperature)
- Root characteristics (depth, length, architecture, health, mycorrhizal associations)
- Crop species

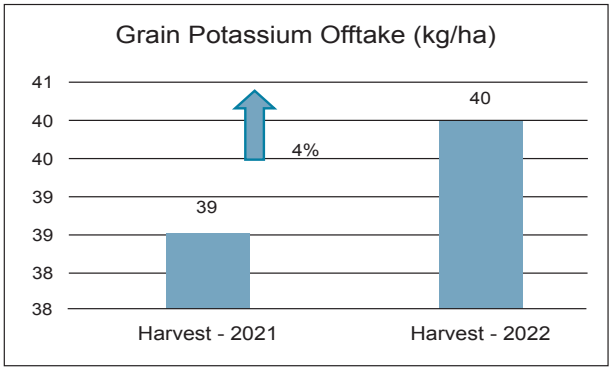
Nutrient offtakes have been a part of phosphate and potash recommendations for decades, although the tables in the Fertiliser Manual do not always make this very obvious. The standard tables showing P&K recommendations at different soil indices are based on 'typical' yields for each of the crops listed. Within this figure is a two-part calculation;

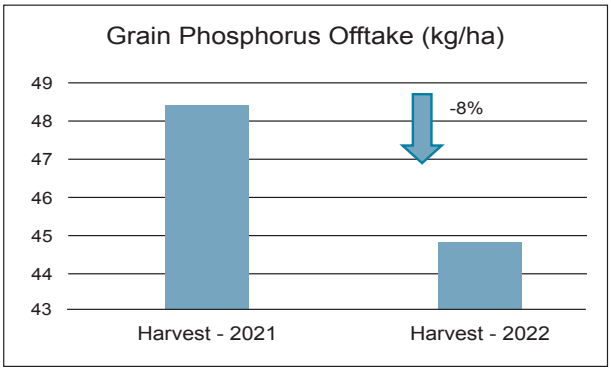
- one based on the removal of nutrient by the crop and
- one which aims to build, maintain, or run down the soil index.

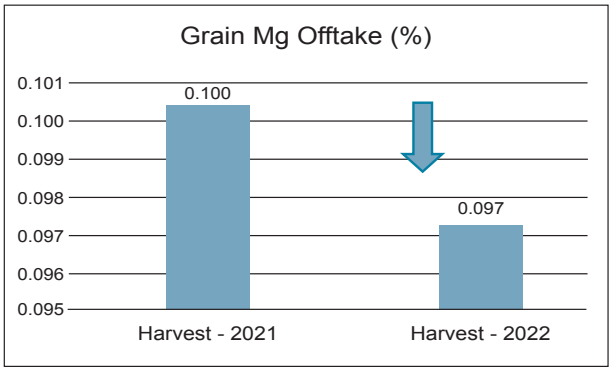
The table at the front of the book shows the values that are on average removed by each crop per tonne harvested. A review of these values by AHDB began in 2018 with around 2,800 data points analysed by the research team. The data was found to be highly variable, which points towards sampling at harvest as a more accurate measure of true offtakes based on site and season specifics. Analysing the grain after harvest can help to indicate whether nutritional input decisions during the season where appropriate.

Data from NRM's grain analysis service, was compared for harvest 2021 and 2022. There was a 4% lower N offtake, 8% lower offtake for P, and a 3% lower grain offtake for Mg in 2022 compared to 2021. However, there was a 4% higher offtake for K.









The two years were significantly different in terms of weather conditions, especially during summer, which was much drier and hotter in 2022. Nutrient mineralisation and mobilisation could be lower under such conditions, resulting in lower overall offtakes during this year.

The crops senesced rapidly in 2022 due to the lack of soil moisture and high temperature, resulting in lower root-ward movement of K in 2022 compared to 2021. This was confirmed in 2018, a similarly hot and dry summer, where elevated levels of K were found in both the grain and straw. Again, the prolonged dry

spell in that year during the build up to harvest meant many crops senesced prematurely. In these situations, some of the natural plant processes are not fully completed. Where the grain fill period is shortened, elevated potash levels may remain in the grain and straw at harvest.

As the crop matures and senesces the cells of plants crack, allowing some of the potash they contain to be washed back into the soil. Where there is little or no rainfall prior to straw being removed from the field, it will result in elevated nutrient concentrations as less potassium is washed from the harvested straw back to the soil.

Grass Silage Sampling

It is not just arable crops where sampling harvested material may prove beneficial for fine-tuning input decisions, grassland could benefit from the same approach too. The revision of the Fertiliser Manual offtakes in 2018 included samples for grassland, and although it was felt there was insufficient evidence to justify changing the values, there were some examples where the recorded offtakes showed to be very different from the standard figures used in the guide, particularly for potassium in first cut silage. The Fertiliser Manual suggests potassium offtake for silage is 2% on a dry matter basis (equivalent to 6 kg/fresh weight tonne for a 25%DM crop). Samples recorded by Thomson and Joseph have consistently shown K offtakes to be higher than this (Table 1). The average for the three seasons 2018-20 was 2.80, a 40% increase over the figure used in the Fertiliser Manual. This data is referenced in the latest RB209, however it appears as small print below table 3.2 (p10 Section 3) and therefore could easily be missed (see table 2 below).

Crop material	Phosphate (kg/t of fresh material	Potash (kg/t of fresh material
Grass - Fresh grass (15-20% DM)	1.4	4.8
Grass - Silage (25% DM)	1.7	6.0
Grass - Silage (30% DM)	2.1	7.2
Grass - Hay (86% DM)	5.9	18.0
Grass - Haylage (45% DM)	3.2	10.5
Wholecrop cereals	1.8	5.4
Kale	1.2	5.0
Maize: Silage (30% DM)	1.4	4.4
Swedes (roots only)	0.7	2.4
Fodder beet (roots only)	0.7	4.0

The offtake values are based on herbage or forage concentrations of 0.3% phosphorus (P) and 2.0% potassium (K) (on a DM basis). Large datasets of forage analyses show the five-year average (2012-2016) concentrations are 0.33% P and 2.75% K. Offtake values should be adjusted based on actual figures from analyses.

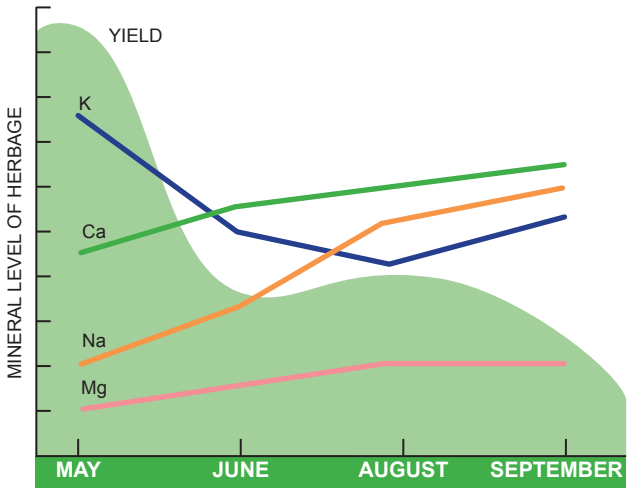
Table 2. Phosphate and potash in crop material
Fertiliser Manual Table 3.2

This difference in offtake means a first cut silage crop yielding 23t/ha would be estimated to remove 138kg/ha K_2O, but would actually be removing closer to 200kg/ha K_2O. In time, if not corrected, this could lead to a reduction in soil levels and subsequent yield penalties, even where 'appropriate' rates were assumed to be applied.

Element	2018	2019	2020
Calcium	0.61	0.61	0.62
Phosphorus	0.35	0.35	0.34
Magnesium	0.19	0.18	0.19
Potassium	2.73	2.91	2.77
Sodium	0.25	0.28	0.31
Chloride	0.98	1.04	1.12
Sulphur	0.24	0.24	0.24
CAB meq/kg	+381	+423	+376

Table 1. Macro-Minerals Mean Concentration (% DM 1st Cut Silage),
Thomson & Joseph 202

The differences between the average value used within the Fertiliser Manual, and the values recorded by Thomson and Joseph could come down to the pattern of potassium uptake by grass. The Fertiliser Manual figure is an average for grass silage across all cuts, whereas the T&J result relates only to first cut silage. As shown in the graph below, the natural pattern of uptake of minerals such as Potassium (K), Magnesium (Mg), Sodium (Na) and Calcium (Ca) varies during the growing season. The dry matter of young rapidly growing grass, especially in the spring, has a high K content which declines as the season progresses, whilst the concentration of other minerals increases through the summer.



Mineral level of herbage through the season