Our Phosphorus Challenge

By Roger Sylvester-Bradley

We are used to analysing soils for phosphorus (P) and know that those with 16 mg/l of available P or more are deemed to be above Index 1, so crops should be adequately supplied. However, the idea of analysing P in grain was only introduced into the AHDB Nutrient Management Guide (RB209) last year, with the suggestion that cereal crops having less than 0.32%P in their dry matter had probably lost some yield due to inadequate P uptake.

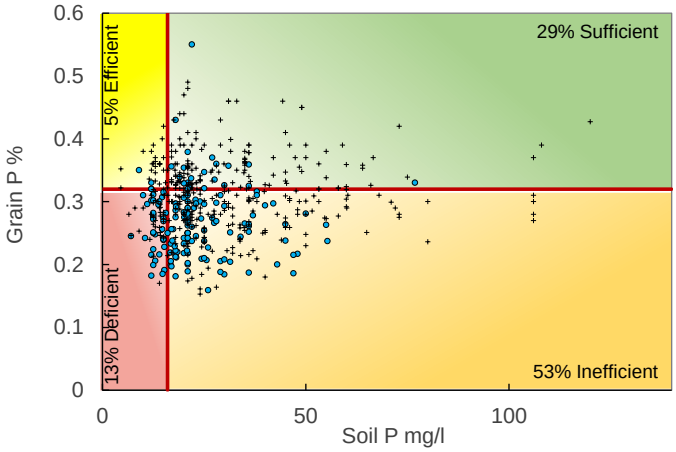

Fig.1 How grain P status of 617 cereal crops did not relate well to soil P status in YEN 2020. Crops on soils with pH≥7.5 (blue dots) had less grain P than on lower pH soils (+).

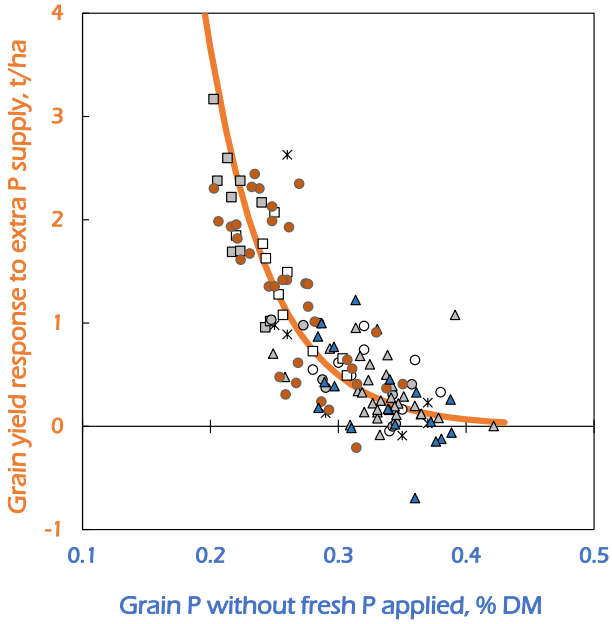

Fig.2 How yield response to increased P supplies related to grain P level of untreated plots in long-term P trials.

About 180 farms analysed grain from over 600 grain crops in 2020 – the first year of YEN Nutrition – and the results are shown in Fig. 1. Worryingly, grain analyses suggested that most crops (>60%) struggled to acquire enough phosphorus (P) through their life, despite the P status of ~80% of fields being deemed "adequate", and despite applications of P on >80% of fields. High pH soils were most commonly affected. These results reflect those from the Cereal YEN in 2016-2019. So, it appears that the arable industry has a significant challenge to avoid shortfalls in P nutrition being commonplace.

We don't know for certain how economically damaging these low levels of P uptake are, but, based on yield responses to P averaged across many long-term experiments (Fig.2), assuming last year's prices for grain and fertiliser, and an average field size of 12 ha, the average loss in profit on fields producing grain with P less than 0.32% was ~£2,360!

Of course, a crop's uptake of P depends on more than just the soil P Index; particularly:

- the intensity of its root system within the topsoil, where most of the available soil P is normally held,
- the moisture status of this layer during the summer when the crop is needing its fastest P uptake,

- sustained microbial activity (i) to keep mineralising available P from soil organic matter and, (ii) through organisms like the mycorrhizae, to assist the capture of this highly immobile nutrient within the soil.

Crop P uptake is multi-faceted, which adds to our challenge, and with the sensitive tool of grain analysis only being introduced recently, we do not have extensive evidence of products or practices that can make a real difference to P uptake. It should therefore be worth collaborating between farms to collect as much evidence as possible on how best to meet the phosphorus challenge.

ACTION: (On each field; and possibly on sub-field zones, if big differences are known)

- Check soil P levels routinely (at least every 3-5 years)
- During May & June, inspect and judge adequacy of topsoil rooting (>5 roots per cm^2)
- Measure yield and analyse grain for all nutrients, including P
- Calculate the accurate phosphate (P_2O_5) offtake (provided in YEN Nutrition reports)
- If grain P is low (<0.32% DM), and soil P is Index 3 or more, take steps to improve rooting or root activity in the topsoil. Maybe also consider testing (using combine monitor &/or grain analysis on part-tramlines) products claiming enhanced P-uptake (foliar sprays; mycorrhizal inoculants; etc.)
- If grain P is low, and soil P is Index 2 or less, choose sources of additional P carefully; do not assume water solubility = availability of P from fertilisers. Slow-release products can work better.
- Favour manures or fertilisers (e.g. struvite) which release P slowly, or choose fertilisers which encourage localised acidity (e.g. diammonium phosphate)
- Apply P annually, enough to replace offtake by each further crop.

Also consider entering YEN Nutrition here and forming a Nutrition Club with neighbouring farms, so we can crack the phosphorus challenge together.