Getting back to basics on major plant nutrients

Rumbletonrig and Castlemains
Climate Change Focus Farms

Notes from meeting on 3rd February 2016

This was a joint meeting of the discussion groups from Rumbletonrig and Castlemains. It reviewed the importance of getting nutrient applications right for the growing crop and then visited an Anaerobic Digestion plant at Standhill Farm.

Productive plant growth - achieving target yields

Ensuring the correct supply of nutrients are available for the growing crop will support productive plant growth, be it for grass or cereals.

It maybe not fashionable, but balancing nutrient applications based on soil test results increases the likelihood that you will achieve target yields and helps you to make the best use of nutrients, reducing emissions and environmental risks. It could mean you are getting more value for money from applied nutrients, be it from livestock or bagged fertiliser. That's why carrying out routine soil analysis every 4 to 5 years and taking actions based on the results is so important. Plants require nitrogen, phosphate and potash for healthy productive growth. Here we recap some of the key points about these essential plant nutrients discussed at the meeting.

Nitrogen

Easily lost if applied at the wrong time for the growing crop.

Taken up by the plant as nitrate (NO3) but is easily leached from soils in runoff or lost through erosion. Ammonium (NH4) is converted by soil microbes to nitrate NO3 (in a process called nitrification). Urea (NH2) needs to be converted to NH4 then NO3 (which is done by soil enzymes). Can also be lost to the environment as ammonia NH3 (volatilisation). Greater losses can occur on high pH soils >6.5 and under dry warm conditions.

Focus Farm meetings are free to attend and all farmers are welcome. Find us on Facebook or follow us on Twitter @SACFarm4Climate. For Rumbletonrig contact farm facilitator Donald Dunbar on **01835 823 322,** email donald.dunbar@sac.co.uk; for Castlemains contact Mary-Jane Lawrie on 0131 6037523 or email mary-jane.lawrie@sac.co.uk . Theres also more info on our website www.farmingforabetterclimate.org

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Phosphate

Key for root development (early growth) and ripening process

Deficiency symptoms include a dull blue green purple leaf and delayed ripening. Phosphate is a finite, non renewable resource, mined as calcium phosphate (ground rock phosphate).
Soluble forms -treat with acid to increase concentration and availability. Triple super phosphate 47% P2O5 95% water soluble but does not remain soluble.
Timing is important if deficient - seedling establishment, early spring growth, dry soil condition in spring sown crops. Its easily lost into the environment when washed out as soil sediment causing nutrient enrichment in watercourses and algal growths (eutrophication).

Potash (potassium)

A key nutrient for water regulation in cell sap, osmotic potential, plant turgidity and enzymes for photosynthesis.

Deficiency symptoms are lighter older leaves plus scorched tip similar to frost damage, older leaves can become totally white. Crops are more prone to lodge with small & shrivelled grain.
Potash is another natural finite resource mined as murate of potash 60% K_2O or manufactured as potassium sulphate 50% K_2O + sulphur. Potash is water soluble, large amounts are taken up by vegetative growth, therefore immature harvested crops remove higher levels from soil reserves e.g. silage. As a crop matures much is returned to the soil. Expect a higher return of potash to soils in a wet season or if a delayed harvest.

Sulphur

The fourth major plant nutrient

Deficiency symptoms include pale younger leaves, also stunted crop in cereals. It can be leached from the soil so deficiency is more likely on sandy, shallow soils or soils low in organic matter.
Apply as elemental sulphur or in readily available sulphate form in fertilisers e.g. ammonium sulphate. Apply in spring as very little taken up by leaf (2%); the main uptake by the roots from soil. Both muck and slurry are good sources of sulphur.

Soil testing using GPS

Knowing soil nutrient and pH status will inform what you need to apply

Guest speaker Douglas Steven from Crop Services gave a talk on GPS field sampling with a focus on soil pH maps which allow variable spreading of lime.

During the winter Crop Services sampled 4 grass fields using GPS mapping. John opted for a ¼ ha sampling grid for pH and a single zone sample for other nutrients.

Table 1 highlights how the traditional W pattern sampling hides the variation in pH across the fields when compared to the data from the GPS sampling.

Table 1: Comparison of pH results between GPS and traditional soil sampling:

	Field 1	Field 2	Field 3	Field 4
Crop	TGRS4	TGRS3	PGRS	PGRS
Average field pH	5.6	5.9	6.0	5.8
Grid pH range	5.5 – 6.1	5.7 – 6.2	5.4 – 6.2	5.3 – 6.2

Grid sampling for pH allows targeted application of lime. Using the GPS 1/4ha grid does increases the cost of sampling but provides a more accurate pH map of lime requirement, helping to remove pH variation across the field faster. If these fields had been sampled using the traditional W pattern, the lime application would have been too low to correct the areas with low pH and production would still be adversely affected. **The results show that GPS sampling for pH is not just for arable farmers and there are clear production benefits for grassland farms as well.**

The table below shows the total quantity of lime required by both sampling techniques is similar in field 3 and 4 with field 1 requiring 11 tonnes less lime and field 2 requiring 12 tonnes more lime.

Table 2: Lime Requirement (tonnes/field)

Lime requirement / field	Field 1	Field 2	Field 3	Field 4
W Pattern	108	24	37	29
Grid pattern	97	36	37	28

The important benefit of using the GPS technique is the purchased inputs are applied where they are required and where most production benefit is gained giving a win:win for the business and climate change mitigation.

Phosphate and potash status

Phosphate and potash were sampled as a single zone. The recommended target for permanent pasture is M- and for arable fields M+. The results show John's fields at Rumbletonrig are within or above this target.

Table 3: P and K status

	Field 1	Field 2	Field 3	Field 4
P	M+	M+	M-	M-
K	M+	H	M-	M+

To maintain fields at target levels applied nutrients need to be roughly in balance with the nutrients of crop off-take.

Autumn cereal P and K requirements

John's autumn cropping consisted of one field of winter barley and oats and two field of winter wheat. SAC Consultant Donald Dunbar shared tables with the group that showed P&K status for each field, the expected crop removal with adjustment to correct low or high field status. The actual bag and muck application was also detailed with a financial value put on the difference between required and actual.

Donald's calculations showed the bagged fertiliser has been adjusted to reflect the field nutrient status and expected crop removal, however the additional FYM applied had not been fully taken into consideration. If it had, there was a potential **saving in purchased P&K of approx. £3,800.**

Anaerobic Digestion

The second half of the meeting looked at energy production from anaerobic digestion (AD). Jim Campbell, Renewables Team Leader from SAC Environment & Design team provided an overview of process and financial feasibility.

The event finished with visit to Standhill dairy farm courtesy of Jim & Annie Shanks to view a farm scale anaerobic digester using slurry from Jims 220 dairy cow herd plus wholecrop triticale, winter rye and grass silage feedstocks.

The group saw how the produced gas goes through a combined heat and power unit (CPH) which supplies heat for the digester and to dry woodchip, plus electricity for farm use. Any surplus is sold into the electricity grid. Digestate from the AD plant is applied to fields using an umbilical system; smell from the applied digestate is greatly reduced when compared to slurry.

The photo below shows from left to right :

1. Feed intake hopper,
2. Primary digestion chamber
3. Gas flare
4. Secondary digestion chamber
5. Gas scrubber and the combined heat and power unit.