FARMEXCELLENCE

AHDB

Northampton Monitor Farm meeting report

Soil health (nutrition below ground)

Speakers: Elizabeth Stockdale (NIAB) and Simon Cowell (Henry Cowell & son)

Date: 18 December 2018

Venue: Cold Brayfield Village Hall

For more information, visit: cereals.ahdb.org.uk/northampton

Meeting summary

- Use plants and inputs of organic matter to feed your soil regularly
- Maintain your soils at the right pH and supply your crops with nutrients in the right amounts in the right place at the right time
- Move soil only when you have to
- On some farms, reducing inputs and cultivations has led to significant improvements in soil health
- Maintaining good soil health through reduced cultivations and increasing organic matter content can be key factors in controlling black-grass
- Home-produced compost can be a good source of organic matter

What is good soil health?

Elizabeth Stockdale

Knowing your soils

- All land is unique in terms of climate, soil, etc. but different areas may have similar constraints
- Soil is not the same field by field or even within a field
- The best approach to understanding soils is to use spade and your own observations
- The key is knowing your own soils particularly in your own context
- Create your own benchmarks:
- What does your worst soil look like?
- What could your soil look like? Look at soil under a hedge

Soil sampling and testing

- It is important to take samples so that you have an idea of soil chemistry
- Use targeted tests for pH, P, K, Mg, organic matter and trace elements
- Within the next 5 years we will also be testing for biological indicators

What does good soil management look like?

Soil physics, chemistry and biology are all equally important and all affect each other

Biological

- Feed soil regularly through plants and organic matter inputs
- Only move soil when you have to
- Diversify plants in space (how the edges of a field affect the middle) and time (through the rotation)

Chemical

- Maintain optimum pH
- Provide plant nutrients (the right amounts in the right place at the right time)
- Know your soil textures and minerals

Physical

- Understand your soils' limits to workability and trafficability
- Optimise water balance – get the drainage right
- Improve soil structure through effective continuous soil space

Biological farming – Simon Cowell's story

Background

- Growing arable crops on heavy clay soils in Essex
- Ex-dairy farm
- After the cows went there was too much grass growing
- Stopped applying N
- After a few years the same fields were producing almost as much grass as when N was applied
- Biomass produced was nearly as much as wheat
- Conclusions:
    - if you add no inputs and leave it alone, stuff will grow
    - if you could get this system to work in an arable field you would be getting something for nothing

Soil improvements

- 15 years ago the arable land was just clay and it wasn't working
- There is now a deep layer of topsoil (7" deep), rich in organic matter, with organic matter extending down into the clay
- Soil testing showed high organic matter content particularly in the top third
- These soils are historically high in Mg
- Gypsum has been added which seems to help the soil but hasn't had much effect on soil test results
- Soil test results for P and K look low but this doesn't tell you what is available to the plants

Ecological succession and soil health

- Over time, land naturally goes through a series of changes from bare soil and rock to mature woodland
- This occurs by sequential colonisation by plants
- Changes also occur in soil microbes
- Soils under bare rock contain 100% bacteria and under woodland 100% fungi
- For grassland 50/50
- Cereals grow well with a ratio near to 50/50
- Weeds do well in soil with 95% bacteria
- Black-grass grows best with soil that is 85% bacteria and 15% fungi
- When you keep adding inputs and cultivating you push the soil towards bacterial
- You need to give the biology a chance

Black-grass and soil health

- Black-grass doesn't grow well in good soil
- It dominates when anaerobic bacteria are dominant and when high levels of soluble nutrients are present, especially N
- The only way to maintain anaerobic soil is to not cultivate and have high organic matter
- On this farm, black-grass is now susceptible to herbicides to which it was previously resistant

Basic principles – how soil health has been improved

- Do not cultivate ("I would rather miss a whole year's crop")
- Changed cropping to halve N use – legumes, linseed and spring crops
- No P and K for 20 years
- Molasses (3%) with liquid N for improved C:N ratio
- Reduce chemicals wherever possible

- No chemical seed dressings
- No fungicides ("healthy soils grow healthy crops")
- Try to cut out insecticides although still need to spray for BYDV
- Growing low input crops – perennials – lucerne and herbage crops ("similar to growing organically")
- Inoculate with home-made compost
- This is treated as a biological inoculant, with very small amounts spread on the field

Trials with wheat

- Blending varieties
- 4 hard wheats (mainly group 1) from 4 unrelated lines were mixed together (half a ton of each) and drilled
- Saved seed from the blend was re-drilled in successive years
- Now in 5th generation
- Main advantage is increased disease resistance

Mycorrhizal fungi

- The amount of mycorrhizal fungi colonising plant roots varies between wheat varieties
- Overall very high levels were measured

Growth regulators

No growth regulators are used because the wheat is slower growing and you don't get the really long internodes

Cover crops

These are not needed over winter to retain high mycorrhizal levels

Lucerne and black-grass

- Lucerne provides a 3 year break with the advantage of needing few inputs (no fertilisers)
- However it is an ideal companion for black-grass
- Black-grass was supressed by putting a grass in with the Lucerne
- This companion cropping method could allow crops to be grown without herbicides

Compost

- Horse manure from livery yards is heaped in a long line and mixed with a composter
- Usually 5-6 turns in 3 weeks produces good compost
- This is left until the following autumn
- By then it is no longer hot but is active
- The compost is spread by a contractor
- Also experimenting with a new compost mixture containing:
    - woodchips
    - grass cuttings
    - gypsum
    - topsoil (acting as an inoculant)
- Which is mixed with the compost turner which takes about 20 minutes whereas a loader bucket would take all day

- You need to turn it more quickly if it is getting too hot (to avoid harming the soil biology) and the mixing needs to be thorough
- The compost is not analysed nowadays
- Nutrients are tied up in the organic matter
- Only small amounts are applied
- It is a biological process, not physical

Direct drilling

- Using a 3 metre tine drill
- Wide low pressure tyres
- The most important thing is to get the slots to close straight away, otherwise the clay dries unevenly and leaves the slot open
- To help slot closure the field is chain harrowed

Discussion based on Q&A – Elizabeth Stockdale

Managing P

- Phosphorus is affected by minerals in the soil (such as calcium phosphate and hydrophosphate)
- The key to releasing P from these minerals is pH
- At high pH it locks up with Ca and Mg, and at low pH with Fe and Al
- This sets the optimum pH
- All soils have an inherent reserve but this is very slow to trickle out so pH is very important
- The P index measures how much might trickle out in a year, i.e. available P
- Index 0 – you might get a response
- Index 2 – expect more
- It is probably a good idea to try to maintain the index
- All organic matter contains P which cycles
- P is very slow moving in soil because it is easily locked up with other minerals such as Ca
- It is very important to supply P to plants
- Adding some rock phosphate to the compost (above) might help
- Also, look at how the plants are responding to the system

Managing P in high pH soil

- A bit of P will be available when you apply it
- Apply when plants are there to take it up (so not in Autumn)
- Organic sources such as biosolids can be good sources of available P in some areas
- Look at plant tissues to check if there is an issue
- Good scavengers of P tend to have an acid root system, and plants nearby can take some of this P from them
- This system is not fully understood

Using gypsum

- Added to high Mg soils
- Clay is made up of layers held together by divalent cations (2+ charge)
- You can break up the structure by shaking it with salt because the Na+ (sodium ions) invade and push it apart
- On very high calcium soils the structure is very strong due to the divalent calcium ions holding it together
- Magnesium soils do not behave in the same way
- Gypsum supplies calcium and opens the soil up, allowing the plants to root
- There is no magic ratio but both Ca and Mg are important
- On heavy clay soils gypsum can have a big effect if Ca levels are low
- Balance is important

Applying potash

- On sandy soils K is best applied in spring
- It is not held in the soil – treat it like N
- On medium and heavy soil – not much different

Mycorrhizal fungi

- Invade roots and grow out in a web through the soil
- Effectively they create a huge increase in crop root area
- They follow the life cycle of the plant and need to go through the full cycle
- Winter cover crops are not much help to mycorrhizal fungi

Testing for mycorrhizal fungi

- The current test for mycorrhizae measures the % of root area surface infected with mycorrhizae which costs £30–40
- But the figures are difficult to interpret – what do the figures tell you?
- You can get variation between different soil types and at different times of year
- We need a test that tells you if there are enough mycorrhizal fungi in a field
- Similarly we need a test that can do the same for N-fixing bacteria for legumes
- At present we don't have enough good data available to help you make a decision

Inoculating compost

- Take soil from a good growing area ("Old science, good husbandry") where it smells better
- Turf is a good inoculum
- There are also many different materials available that are good stimulants for growth

Other organic materials

- Rule of thumb – you shouldn't pay more than £50/t for carbon
- There is no benefit above this
- In most mineral soils it is difficult to apply without doing damage
- Watch micronutrients – you can get an odd balance of trace elements
- Analysis should give clues on the availability of macronutrients which is useful but not perfect
- Which source of organic matter is best?

- It is not the same for all farms
- Try some out on your own farm
- This gives you control of the material
- Factors to consider – transport, soil type, imbalances in nutrients
- Feed the soil regularly
- Each farm needs to work out what works best

Biosolids

- When should you apply sewage sludge?
- It is more to do with soil condition than getting the timing right and it can be difficult to get this right
- Ideally you need a good relationship with the contractor

Green waste

The problem is plastic unless the material has been screened and this might cost more

Find out more – Links to AHDB information sheets or research

GREATsoils
Soil biology and soil health partnership
Cover crops, drainage and targeted cultivation for improved soil structure
Soil assessment methods
Biological tests for soil health
Field drainage guide

For more information or to find out more about Farmbench, AHDB's benchmarking tool, contact: Judith Stafford
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