NUTRIENT MANAGEMENT ON ORGANIC FARMS - John Howell

- **Sources of soil organic matter**
  Crop residues (2/3 of corn nutrients stay on farm after ear harvest), cover crops, manure, compost

- **Cover crops and N**
  - Rye can take up leftover N at a rate of 70-80 lb/ac when planted in Sept.
  - If vetch grows til mid-May before plowdown, it can contribute 100 lb/ac of N – but means that you’ll be planting a cash crop a bit late. Once plowed down, it releases nearly all its N w/i a few weeks, which may be subject to leaching. If grown with rye, the C from the rye might help to bind up some of the N and prevent leaching.
  - A cover crop doesn’t actually ADD nutrients to the soil per se, unless it’s a legume. But it can help keep existing nutrients from leaching, and also can pull up nutrients from deep subsoil level.

- **Summer smothers**
  - Sudex is very useful if you’ve grown an early crop – you can follow it with sudex, which produces a large volume of biomass to help build soil organic matter. It’s a heavy feeder, so you may need to actually fertilize sudex. Then plow it down in Sept and put in a winter cover crop.
  - Buckwheat is usually grown as a summer weed smother but doesn’t produce a lot of biomass.

- **Compost uses, and some cautions**
  Compost is useful for building soil organic matter and for providing slow-release nutrients. Be careful of using composts from unknown sources and of using compost from the same source for many years – can result in severe pH or nutrient imbalances. Always get it tested. Beware of compost sources used in GH; if it is at all immature, it may produce ammonium, which is toxic to plants.

- **Cover crops can help mop up excess N from manure**
  Manure may only be applied to organic crops 90 days (for crops growing higher on the plant) or 120 days (for crops growing on or in ground) before harvest of edible portion of crop. When applying manure, you can count on 5 lb/ton of ammonium nitrate (very leachable) for dairy (double that for poultry) – calculate how many tons you’re applying and figure out how much cover crop to put on to mop up the leachable N

- **Can you comment on different green manures and their ability to hold nutrients?**
  - oats will not mop up as much as winter rye, and will winterkill instead of continuing to grow in the spring (maybe only 50% as good)
  - brassicas will also winterkill, & will release their N quickly
  - experiment w/ planting rye continuously from Aug. through Oct. in western MA – rye planted after Sept. 1 in that climate takes up much less N
  - comparison of different cover crops, what they picked up in the fall, and what was available to crops in the spring – the winterkilled crops picked up nutrients but the
nutrition was gone in the spring. - but was it really gone or was it tied up in microorganism bodies?

- many farmers ask, what happens when I mow my cover crop?
- at Cornell, we use overwintered rye in the spring to strip soil of N for fertility trials

- There is a direct relationship between soil organic matter and Cation Exchange Capacity (CEC)

As you increase soil organic matter, you increase CEC, which has big implications for overall fertility management. CEC is a measure of the capacity of a soil to hold nutrients – sandy soils tend to have a naturally lower CEC, while certain clays have a higher CEC.

Looking at soil tests:

- Nutrient saturation in a high-CEC soil

1st test handout: High Mg. and Ca rate with a low pH - how is this possible? CEC is 24.1, in the top 1% of soils. This means that this soil can actually hold many times as much Mg and Ca as a normal soil, so Mg and Ca are actually at a really low saturation. On diff. tests, like in ME, the high-med-low bar graph ratings are actually based on percent saturation, so you would not see such a high mark for soil with a low saturation of Mg and Ca.

- All soil tests use different benchmarks for low-med-high

The whole thing is pretty flawed unless you have a really good idea of exactly what you’re looking at. Also, the results depend on the acid used by the lab to extract nutrients from the soil, so the results may not give you any kind of accurate idea of what is actually available to your plants during the growing season. John responded that the lab tests are trying to use an extractant that will actually mimic the plants’ ability to take up nutrients.

- P is probably the nutrient that is most sensitive to low pH – generally, for all nutrients, work to adjust imbalanced pH before adding fertilizers

2nd lab test handout: So given these test results (low P, high Mg and Ca, low pH, high avail. N), what do you tell a farmer to apply? Add some dolomitic lime to raise pH, add K to raise saturation level (Sulpomag, mined potassium sulphate). Vern wouldn’t use dolomitic lime, and wouldn’t recommend sulpomag – potassium sulphate would be a much better source of K. Vern wouldn’t recommend addition of any compost or manure. Caragh would add poultiy litter. General concensus: Don’t add P until you’ve adjusted the pH, because this will make more P available. George pointed out that you should first ask what crop will be grown on this soil, because these results might be adequate for sweet corn. Bone meal would be a good choice of soluble P. Brian would add lime and compost – others disagree because soil organic matter is already at 12%. How did it get so high without P being higher? The soil must be mostly humus to have such a high CEC. It must be a geologic deposit of formerly anaerobic muck.

Ca, Mg, and K compete to get into plants. If you have too much Mg, you can get into K deficiencies. K should be at a 2-5% saturation range, Mg. should be around 15%, Ca should be at about 65% saturation (Albrecht formula)
Vern says in terms of P field tests, ag. educators have been pushing way too high a number. P index (based on proximity to water, level of P in soil) is really related to your soil type, so some researchers are now removing P from starter fertilizers in high-P soils. Mena says in a greenhouse situation, it would be helpful to have two tests, to understand what your soil has available now, and what’s likely to become available during the season. Lab tests are actually fairly consistent for other nutrients, but P in particular really varies over different labs.

Nutrient management gets much more complicated when you’re talking about growing a diversity of crops on a very small area.

- **Nitrate and Soil tests**
  Soil tests are relatively predictive in terms of NO3 – we just don’t know what happens after the soil test in terms of leaching, mineralization, cold weather, etc. Factors affecting N mineralization: soil temp (50-90 degrees), soil pH (above 6), soil aeration, soil moisture, C/N ratio

- **Adjusting a low pH – should you, and if so, how?**
  3rd soil test: very low pH, low nitrate, low P, K, Ca, and Mg, 12.9% soil organic matter
  What would you do? Recommend they grow blueberries! If they really want to grow veggies, add lime and wait to see how the rest of the nutrients adjust. George would recommend following the liming with a cover crop of Japanese millet, which can grow under a variety of pH and fertility requirements. In NY, recommendation is no more than 2 tons/ac of lime at once – in VT, recomm. is no more than 2 tons/spring and 2 tons/fall. What would happen if you put on 6 tons/ac all at once? End up with a chalk layer on the soil. Shock the soil – not good to just leave it on the surface – definitely work it in! Could use wood ash too.

  What about next year’s growing season? Perhaps you could tailor the crop to the soil for this year, until you can get the soil closer to where you want it.

Don’t rely on soil test to determine levels of micronutrients- only as a red flag for very low levels. Vern assumes that they’re all in there if the soil organic matter level is there. Mena suggested a tissue test could tell you about the micronutrient levels (but tissue tests only tell you how you did, not how you’ll do in the future).

- **How do you use the CEC to make soil recommendations?**
  It is an indicator of what type of soil we’re working with – the capacity of the soil to hold nutrients. You don’t necessarily make recommendations to people to directly change their CEC. A high CEC is usually thought of as a good thing (because it means high capacity to retain nutrients), but not always, because it can mean low availability of those nutrients. Humus (soil organic matter) is the primary contributor to the CEC in some areas. In other areas, the types of clay present contribute to CEC. Some soil tests require people to check off what type of soil they have, to see if it correlates to the CEC test result.