

**Workshop Title: Managing Nutrients and Soil Health in Organic Field Crop Systems**

**Speaker(s) & their titles:** Dr. Derek Lynch and Rosalie Madden

**Executive Summary:**

This workshop presents Rosalie Madden's Masters research to-date on nitrogen in wheat crops, and the most cost effective ways to get nitrogen available to the plant when it needs it. Dr. Derek Lynch discusses several factors in evaluating soil health, comparing organic and conventional systems and evaluating how successful the organic system is in improving soil health.

**Detailed Notes:**

**Rosalie Madden:** Food Production and Environmental Science, Crop Extension with University of Vermont, currently undertaking an MSc with Dr. Derek Lynch at the Dalhousie Agricultural Campus.

Heather Darby of the University of Vermont (UVT) is coming to Nova Scotia in the new year to talk about grain production; Rosalie recommends it as a talk worth going to.

Rosalie will talk about Nitrogen, centred around wheat. The notes will follow her slides.

**Why Nitrogen?**

The goal of feeding a crop enough nitrogen is getting it to the crop when the crop needs it most. Nitrogen in compost or manure is not readily available; it must be mineralized to be available to the crop.

**Graph showing uptake on N.** By early to mid tillering, it has taken up the nitrogen in the first 25 days of growth. The way to get N to plants in organic systems is through legumes, manures and the decomposition of organic matter.

Incubation study at UVT see graph. Tillering starts at 20-25 days in spring wheat.

**What sources of nitrogen?**

**Graph** showing local commonly applied amendments. Krehers Composted Poultry Manure is better. Pro Gro giving lots of nitrogen when you need it. Dairy compost not giving N.

Some farms are implementing on-farm oil seed production to press for selling or biodiesel. The leftover seed meal is high in N, and can be used to feed animals or as an organic amendment. **Graph showing canola, mustard, soy and sunflower meal and comparing to Chilean Nitrate and Blood Meal.**

**Cost analysis**

If applying 150 lbs of plant available nitrogen, how much total N will you have to apply? 2009 prices are shown [here](#). Blood meal quite expensive compared to composted chicken meal, but latter did not give much bang for buck.

### Top dressing

In 2012 Rosalie looked at organic top dressing in winter wheat. See [chart](#). They were experimenting, putting amendments on to see what impacts each would have. 70 lbs of Chilean nitrate at spring green up was the best, but it has been taken off the organic amendment list. Everything else was about the same as manure in the fall, which is cheaper. However it does affect protein. In this case, a grower could ask themselves : why are they growing winter wheat? What do they need for protein levels?

### Green manures

Rosalie's Masters work is in studying different green manures. She is looking at two sites: one in NS and one in QC. She is looking at the N dynamics of each system, and how biomass is accumulated over the season. See [chart](#) of 4 different sampling dates.

Next [chart](#): shows how much nitrogen accumulated. For common vetch it does not matter whether it is incorporated in the fall or spring – it produces the same biomass. Red clover has slightly more biomass when incorporated in spring. Hairy vetch very impressive. However, looking at the breakdown of seed costs, hairy vetch is much more per hectare: \$227/ha compared to red clover at \$65/ha.

Next [chart](#). What does this mean for the subsequent crop. How much N the plant has taken up. No statistical difference between hairy vetch and red clover. However, spring incorporation does result in higher uptake of N by plant.

**Q** Does hairy vetch overwinter?

**A** If planted in spring, no. Research from Manitoba suggests that if hairy vetch flowers, it will not overwinter. But a late season planting would overwinter.

**Q** How applicable is this research to spring wheat?

**A** Very applicable.

**Q** What was the conclusion – which has most N per dollar in spring?

**A** [Chart](#) showing how much N – cheapest is common vetch if incorporated at peak nitrogen accumulation, which is about mid-August. UVT work suggests that an early planting is better, here it may not be the case because our spring seasons aren't as warm. Dr. Derek Lynch responds that early planting is still better for protein, weed competition, etc.

**Q** Any issues for establishment?

**A** Planted with seed drill: some wireworm takeout, but the vetch grows so big and shaggy it was fine. Derek will mention a study on a mix of oats, peas and hairy vetch which drops the cost. Rosalie disked in common and hairy vetch which she would not recommend. Common vetch is dead by end of September; it can be disked in, but hairy

vetch is very difficult: 7000 kilograms of biomass to work with in the fall. It would be more workable in the spring.

**Q** If trying to minimize tillage, and you can flood, can you drown red clover in the spring and have good effects?

**A** Concern that flood will leach out N. Would lean towards two years of red clover instead of one year if using a flood. Educated guess.

**Q** What about flail mowing?

**A** They flail mowed the hairy vetch before disking. Did it help? Not sure, really. Another of Derek's students is looking at roller crimping.

**Q** How much nitrogen is coming from one year of red clover?

**A** When not planting with a nurse crop, they are not experiencing that much N from one year of red clover. They are finding that they are not getting enough protein in grain. If going for good protein in spring wheat, what is best? Rosalie doesn't know as she has not analyzed the data yet. Stay tuned for next year!

### **Dr. Derek Lynch**

We're really interested in soil health in organic farming. The biological process is very much part of what we're looking at.

### **Soil Health**

We believe that soil health is going to improve nutrients for crops. How useful is it to think about Organic vs. Conventional? What you really appreciate is diversity within organic farming.

A short note on soil organic matter: if you look at long-term studies, do we come out ahead in terms of maintaining organic matter, or does the increased tillage reduce it? It seems neutral. Sometimes we're ahead, as Rosalie showed, but we're often putting more back in.

Just measuring total organic matter is boring. We really want to know if we're improving, feeding the soil, supporting microbial life, etc. If you look at quality of material and dynamics of it, we really promote soil.

### **Agronomy**

Unamended plots 30 T per ha (conventional is about 40 T per ha) just using clovers etc. By coming in with a poultry manure product, you could increase marketable yields.

What's going on in soil with long rotations? In contrast to conventional two-year rotations, the organic practice of 4-5 year rotations, we see that the earthworm, biomass, and microbial quotients collapse in first 2 years of rotation, but recover on a 4-5 year rotation. Another farmer asked Dr. Lynch once « Do you mean to tell me that

every time I grow potatoes I'm killing 4 tonnes of earthworms ? » Yes, but you are cycling nutrients, and growing more worms in the end.

### **Fertility treatments experiments**

They decided to push the envelope and try types of compost they would not normally try. (e.g. food waste compost or paper mill compost, etc).

The story was that the one year vetch, oats, and peas mix was as good as two years of red clover and saw less wireworm damage. How much nitrogen do we get per kg? The organic system comes out ahead.

Another study looked at over-winter N losses. Some work over last few years with Brian Lawes doing PhD. Roaslie introduced topic of losing N over winter. Rainfall leaches nitrogen if we plow down red clover in the fall after two years – how does that impact N loss ?

The most striking thing that made a huge difference was influence of a given year's weather patterns: the difference between a wet spring and a dry spring, temperatures being the same. Even though the biomass was there, it wasn't ending up in the wheat crop. The big challenge for organic agriculture is that the season's weather really impacts. The good news is that we are conservative systems, experiencing modest rates of N losses which is good. Organic systems are not so intensive that we have to worry about big N losses.

Improving N synchronicity: Soil testing for N availability is not currently possible – a huge challenge no matter what system you are managing. We need a bit more work on plant root stimulators.

### **Rollers**

The roller was popularized by Rodale. Instead of plowing hairy vetch, what if you roll it? Is it there in the spring? Can you no-till seed the wheat in? Yes. Does it provide weed control? Looking over the next two years on a hairy vetch into wheat into fall rye into a fourth crop. Looking both in Manitoba and NS, and early results show faster breakdown of mulch in Nova Scotia than in Manitoba.

### **Soil phosphorous concerns**

In Europe they seem to have a closer link with manure availability, so they are curious about Canadians talking about low phosphorous levels in soil reports. This is important because P is needed to fix N.

### **Phosphorous in forage production**

Looking at organic dairy farms that had been organic for 10 years or more. Does it affect the production of forage alfalfa and clover?

Yields were good. Most alfalfa was getting good N fixation even if phosphorous was showing low on a conventional soil test. It seems the soil test is the clue here.

How are these organic alfalfa crops managing to get away with low phosphorous? Mychorrizae in the roots. There is lower phosphorous, but higher mychorrizae in organic systems. Far more alfalfa in organic forage. Forage yields in organic can be comparable to conventional. They actually looked at the yield to see how much the crop needed, and the organic system was more efficient, which is kind of neat. The organic system is demonstrating a different relationship with the soil.

### **Differences in AMF (Mychorrizal fungi)**

Is there a difference in types of AMF between organic and conventional systems? YES! The organic AMF is much better for phosphorous efficiency.

### **Alkaline phosphorous slide**

Dr. Martin Entz is working in Manitoba on a long-term study showing low organic phosphorous. Tanner Fraser found enzyme activity higher in the organic system, which makes more phosphorous available to the crop.

### **Can we improve?**

A lot is distinct in organic systems – more variety, less intensive inputs, less nutrient loss footprint.

Buckwheat and Brown mustard showing to be effective – not sure yet if it is compounds in the plants, or just because it is a new crop into the system.

### **Additional thoughts**

There was a cool study out in Ontario this year: a group of ecologists went out on organic soybean fields and compared them with conventional soy fields for nesting songbirds which are dependent on what there is to eat, especially earthworms and round beetles. The songbirds were much more successful in organic systems. The question here is are we doing better on wider ecological scales? That study concluded that the main reason for more food for birds was longer rotations.