2015 ACORN Conference & Trade Show
Delta Prince Edward Hotel, Charlottetown, PE

Workshop Title: Managing Novel Green Manures and Nutrient Sources in Organic Field Crop Systems

Speaker(s) & their title(s): Dr. Derek Lynch, P.Ag (*Dalhousie University - Faculty of Agriculture)*

Executive Summary :
In this lecture, Derek shares some of his experience working with agricultural graduate students in the areas of soil fertility, using:

- Green manures (common vetch, hairy vetch, red clover)
- Biofertilizers (composts, pelletized dehydrated manures)

in organic potato, grains and forage production, and the impact on soil quality.

Detailed Notes:

During Derek's work with potatoes on PEI, he noted that many of the farmers assumed the soil as in good health, when perhaps it may not be in optimal condition. This study analyzed soil conditions while growing potatoes in a 5-year rotation. Some findings included that:

- Earthworm abundance and biomass were lowest during the year in which potatoes were grown, and increased in the preceding years of this crop rotation
- The same trend was present for the microbial content in the soil
- When compared to green compost, pelletized manures (from poultry production) added more Nitrogen (N) and Phosphorous (P), while it had a lower Carbon (C) to Nitrogen (N) ratio
- These manures were worked into the soil during only 1 of the 5-year rotation
- As a result, the crops which received the pelletized manures had a slightly increased yield
- Too much N can produce unfavorable results

The next topic addressed how to meet N requirements on organic farms, and facts about green manures. Some points are:

- Again, N regulation is important for optimal yields, plant growth and timing (too much N isn't good)
- N loss often occurs through soil flux, and drainage

Green manures were tested during a rotation of red clover, wheat and soybeans. Wheat N uptake was recorded, along with other data for 2 years.

- The greatest difference in N uptake from year 1 to year 2 was when manure was incorporated in the fall (clover cut as hay)
- Seasonal influence dominated N dynamics. Derek made a note that the winters here on PEI are very open
- In year 2, wheat yields were 1.5X as high when compared to year 1

- This was due to less N leaching, and the addition of more N uptake (manure addition)
- Organic systems are generally less intense (less environmental impact) when compared to conventional farming

Another topic noted that phosphorous plays an important role in soil dynamics. Some notes on phosphorous from field studies:

- There was no relationship between soil phosphorous, crop yield, and legume biological fixation
- When considering organic soybean yields on PEI, yield increased with the amount of phosphorous present in the soil
- On dairy farms, phosphorous can be taken from the fields, as it becomes a part of milk production through cattle grazing
- In organic soil, low soil phosphorous levels are slowly boosted back up by the activity of soil organisms which help to regulate these levels, over conventionally farmed soils
- Derek noted in the presentation, that "Green manure (buckwheat) phytoextraction of rock phosphate P did not significantly enhance P supply in Ontario, as was also found for a wide range of green manures in California"
- He also noted that "In California legumes in organic rotations influenced soil pH, organic acids and enzyme activity but had a minor overall effect on soil P dynamics"

Next, Derek presented a cropping system study that was conducted (2005-2010) with 5 year crop rotations growing potatoes which varied in green manure type and frequency. Some details of this study:

- Manure added once every 5 years, ~10T/ha
- Types of manures were food waste compost, green manures, fertilizers and paper mill compost
- Paper mill compost had low N levels, while food waste had higher N
- A combination of oats, peas and vetch as green manure source increased yield in potato crops, which is comparable to using red clover for 2 years of the rotation as mentioned earlier
- Food waste compost increased yields, while the paper mill compost did not
- Yields were lower for organic systems in this study (20-25%), however the N efficiency was higher
- Question was raised about possible contaminations of food waste compost, and the mill compost (heavy metals) sources: These two manure sources are still under further discussion, and debate to whether they could be certified for use in this application

A last note for this section was that green manures and supplemental composts improved total organic matter, particulate organic matter and microbial biomass.

In the second section of this presentation, Derek spoke about some of the vetch variations as a green manure source. Here is a list of abbreviations, for the combinations:

- Hairy vetch (HV)
- Red clover (RC)
- Red clover/oat (RCO)
- Common vetch/oat (CVO)
- Hairy vetch/oat (HVO)

Some general points to consider in this section:

- Most of the research has been conducted when these manure crops are seeded in late summer
- HV is currently quite expensive
- Eastern Canada has a short growing season
- Full season manures are RC, CVO, HVO
- Incorporation timing important as well for N dynamics of subsequent crops
- When considering biomass production, N accumulation and least amount of weeds, the HVO combination surpassed the other combinations with CVO and RC following in second place
- The type of green manure planted had much more of an effect than when it was planted (spring vs. fall)
- Derek mentioned that roughly 30 kg seed/ ha was used

- For HVO, seed cost is $227/ha. In fall, 220 kg N/ha was incorporated giving a cost of $1.03/ kg N. Similarly, when seeding in spring 94 kg N/ha was incorporated giving a cost of $2.41/ kg N.

- For CVO, seed cost is $130/ha. In fall, 69 kg N/ha was incorporated giving a cost of $1.88/ kg N (peak N accumulation = 149 kg N/ha with a cost of $0.87 kg N/ha). Similarly, when seeding in spring, 34 kg N/ha was incorporated giving a cost of $3.82/ kg N.

- For RC, seed cost is $85/ha. In fall, 46 kg N/ha was incorporated giving a cost of $1.85/ kg N (peak N accumulation = 88 kg N/ha with a cost of $0.97 kg N/ha). Similarly, when seeding in spring, 54 kg N/ha was incorporated giving a cost of $1.57/ kg N.

- Recall that usually 30 Kg/ha of seed for HV is used

- Q: Can less seed be used for HV variations to offset the cost (e.g. 20 kg/ha rather than 30)?

  A: Derek mentioned he hadn't tried this and that it would be worth the research to observe the effect
- Q: Are legumes inoculated?

A: Yes, not worth the risks in this case, as grad students are doing thesis work

A note before the next section (taken from Derek's presentation):

- Fall incorporation – moldboard plow in fall, disc in spring
- Spring incorporation – mulch left overwinter, moldboard plow in spring
- No-till – mulch left, wheat no-till seeded

Considering no-till systems with green manure:

- Rotation is Hairy Vetch/Oats > Wheat > Fall Rye > Soybean
- No-till method works well with these crops as well, especially because of our open climates here (Atlantic Canada) in the winter, and the possible loss of surface mulch
- If no-till used, no need to roll (crimp) the crops in fall, as the winter will kill them
- Soil temperature regulation and moisture content are more desirable with no-till
- Earthworm populations much higher in no-till systems, but still lower than a reference site which has never been disturbed

Last points:

- Longer green manure season in Atlantic Canada, vs the growing season – good to take advantage of this
- These systems help with wireworms in potatoes; Derek noted that in one instance there were about 50% less after planting HVO