

GREEN MANURES AND DEHYDRATED POULTRY MANURE TO OPTIMIZE FERTILITY IN ORGANIC GRAIN PRODUCTION SYSTEMS

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KEY POINTS

- Green manure options in combination with four rates of dehydrated poultry manure (DPM) were compared at sites in NS and QC using spring wheat as a test crop.
- Wheat showed a positive yield and protein response to green manures vs. a pre-crop of soybean.
- Green manures provided the equivalent of 40 kg N per ha rate of DPM (or 800 kg per ha of DPM product).
- Among green manures, the hairy vetch/oat mix supplied the highest N and supported the highest wheat yield and protein content.
- Hairy vetch can produce 7 tonnes of dry matter per ha, capturing nearly 250 kg per ha of N, of which 40-60% may be available to the next crop.
- DPM application in NS at 120 kg N per ha increased wheat yield 2.8x compared with 0 rate when following soybean (present but less dramatic in QC).
- Hairy vetch/oat + 40 kg N per ha from DPM produced similar yield as 120 kg per ha DPM without a green manure.

ORGANIC FERTILIZATION

A well-planned crop rotation is essential for successful organic grain production. Green manures are crops grown and incorporated (typically without being harvested) specifically to supply nutrients for subsequent cash crops. Nitrogen (N), the most limiting nutrient in organic field crop systems, is typically supplied through biological fixation in legumes. Many organic grain producers in Eastern Canada include red clover, a perennial, as a pre-crop for wheat in order to fix N. Sometimes, however, a perennial green manure may not be an option so an annual is needed. But how does the supply of nitrogen vary among green manure options?

Another important source of N is animal manure, however, manure is not always available on the farm and it may be costly to transport or purchase. Are commercial organic products, such as pelletized dehydrated poultry manure (DPM), a viable nutrient source for organic grain producers? Is there an optimum combination of including a green manure in rotation supplemented by some added manure?

THE EXPERIMENT

A group of researchers in Nova Scotia (Dalhousie University) and Quebec (CEROM - Centre de Recherche sur les Grains Inc.) collaborated to study how combinations of different green manures and supplemental DPM influenced the productivity and quality of organic spring wheat.



Figure 1: Spring wheat trial assessing response to dehydrated poultry manure and different green manure pre-crops in Nova Scotia.

The pre-crops tested prior to wheat were:

Nova Scotia site:	Quebec site:
Hairy vetch + Oat	Hairy vetch + Oat
Common vetch + Oat	Red clover + Oat
Red clover	Oat
Soybean	

Following all pre-crops, DPM ("Acti-Sol" 5-2-3 [Acti-Sol.ca]) was applied at different rates (0, 40, 80 and 120 kg total N per ha or 0, 800, 1,600 and 2,400 kg per ha of DPM product) one day prior to planting wheat.

SUBSTITUTE VALUE OF A GREEN MANURE

The study demonstrated a clear wheat yield advantage of growing a green manure (compared to following soybean) in a system where no organic fertilizer is added. On average green manures provided to wheat the equivalent of an application of about 40 kg total N per ha of DPM (800 kg per ha of DPM product).

Therefore, green manures reduced requirements for supplemental nutrient. The yield benefit was consistently highest following hairy vetch. Yields also increased with

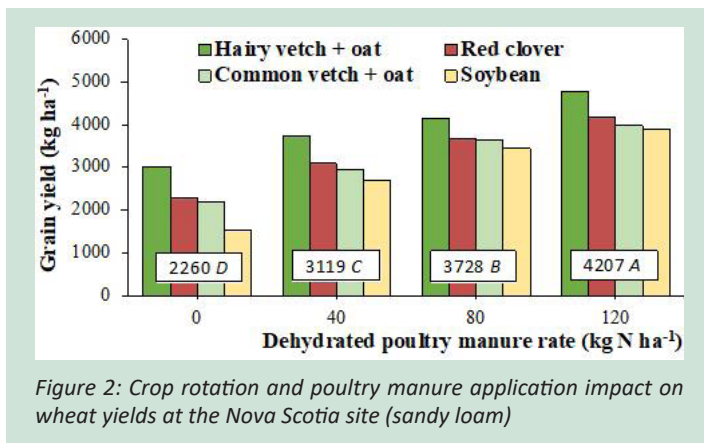


Figure 2: Crop rotation and poultry manure application impact on wheat yields at the Nova Scotia site (sandy loam)

increasing rates of DPM. At both sites, the grain yield obtained from leguminous green manures at all DPM rates (including 0 DPM) ranged from 2000 to 4200 kg per ha compared with 1500 to 1800 kg per ha in unfertilized plots which had soybean or oat in the year prior to wheat.

WHEAT QUALITY

The different leguminous green manures also impacted wheat quality in terms of higher grain protein content. Satisfactory quality standards were attained (12.5% protein) and some treatments of green manures even resulted in premium standards (13.5% protein). But when DPM and green manure were combined, the grain protein content was further increased. Overall, grain protein content ranged from 12.5 to 16% at the Nova Scotia site, and 12.6 to 13.6% at the Quebec site.

HAIRY VETCH: A PROMISING GREEN MANURE

The ability to supply N and the effect on grain yield and protein content was always superior in the mix from hairy vetch and oat than with any other green manure whether combined or not with dehydrated poultry manure.

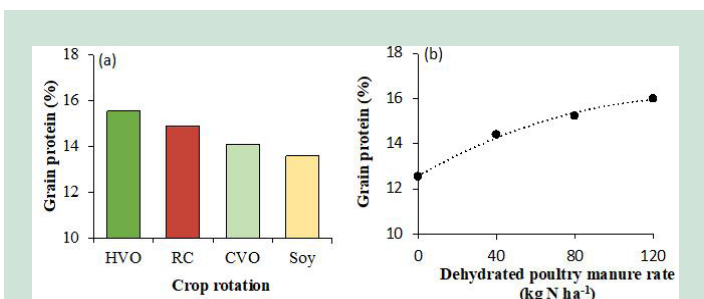


Figure 3: Grain protein in wheat at the Nova Scotia site in the different crop rotations with hairy vetch + oat (HVO), red clover (RC), common vetch + oat (CVO), or soybean (Soy)

This factsheet may be cited as:

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Furthermore, hairy vetch offers many advantages:

- The crop can produce a large biomass over a full growing season, about 7 tonnes of dry matter per ha.
- It can accumulate as much as 246 kg N per ha.
- 40% to 60% of N could be made available for the next crop.
- The thick mulch helps to suppress weeds, support soil biodiversity, prevent erosion, conserve moisture and improve soil tilth, particularly when incorporated in the spring.

Hairy vetch may also offer some challenges; if sown in the fall, hairy vetch is winter hardy and has a high regeneration capacity, and thus added tillage is needed.

WHICH FERTILIZATION STRATEGY TO CHOOSE?

This study has shown that including a legume green manure in the rotation allowed improvement in organic wheat yield and grain quality. Furthermore, of all the green manures tested, hairy vetch was highlighted as a considerable source of nitrogen. Therefore, it is a clear choice to consider for organic wheat production, as long as it fits with farm management options (field equipment) and cost of seed is reasonable (in spring 2020, prices for hairy vetch and organic red clover seed were comparable at ~\$150-\$160/22.7 kg bag in Atlantic Canada).

Responses to green manures and DPM can vary depending on site and climate. Experimenting first on farm, with a strip or single field to test grain crop response and benefits of these novel green manures in rotation, would be recommended before deciding if they are a good fit agronomically and economically.

Read the complete results of the experiment at: [dx.doi.org/10.1139/cjss-2018-0049](https://doi.org/10.1139/cjss-2018-0049)

This research activity is lead by Dr. Derek Lynch under [Organic Science Cluster 2, Activity 8.](#)

ABOUT THE ORGANIC SCIENCE CLUSTER

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SCIENCE CLUSTER 3

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