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# SOIL PHOSPHORUS AND NITROGEN FIXATION ON ORGANIC DAIRY FARMS IN ONTARIO AND NOVA SCOTIA

*Interim Research Report E2009-40*

## BACKGROUND

A recent survey noted that many fields within organic dairy farms in Ontario were low in soil-test phosphorus. Phosphorus is a key nutrient that supports plant growth and legume N fixation.

This project investigates the relationship between soil P levels on forage yield and nitrogen fixation on organic dairy farms in Ontario and Nova Scotia. It also explores the use of organic amendments to improve P supply and the role of soil microbial factors in crop P uptake.

## WHAT WAS DONE: YEAR 1 (2008)

Soil samples were collected during the first harvest. Forage samples were taken before each cut from 28 fields (280 sampling points), mainly in Ontario. Due to very rainy weather in 2008, some actual harvest dates were up to several weeks later than sampling dates. In addition, many fields were harvested only twice rather than the usual 3 cuts.

Samples were sorted and the yield contribution was determined for each type of plant. The research team uses natural nitrogen isotopes ($^{15}N$:$^{14}N$) to determine the amount of N fixation by the legumes, as well as other common forage analyses.

The first results for 2008 are outlined in Table 1.

- In the Ontario fields, legumes (mostly alfalfa) contributed between 26% and 85% of yield, while in Nova Scotia legumes (mostly clover) contributed between 1% and 70% of yield. The average legume contribution is given in Table 1.
- Generally, a decline in legume content mirrored a decline in yield and amount of N fixed. Legumes contributed the majority of the nitrogen harvested (Table 1). This underlines the importance of legumes to nitrogen and protein production in forages.
- Average N fixation was about 90 kg/ha. This is likely an underestimate since the first cut was sampled too early and the fall regrowth was not sampled.

**Table 1: 2008 interim field data, averages**

| | ON ave. | NS ave. |
|---|---|---|
| % legume | 62% | 31% |
| Soil test P (ppm) | 8.8 | - |
| # cuts | 2.2 | 1.9 |
| Forage yield, DM kg/ha | 5736 | 6169 |
| Forage crude protein | 20.2% | - |
| N fixation, kg/ha | 90 | - |
| Legume N harvested, kg/ha | 137 | - |
| Grass/weed N harvested, kg/ha | 49 | - |


**Figure 2. Soybeans grown with increasing P supply, from 0 (at left) to 135ppm added P (at right)**

- Soil-test P in ON fields (Olsen-P) varied from below 4ppm to about 16ppm.
- As shown in Figure 1, there was no clear relationship between soil-test P and forage yields. Similarly, a trend between N fixation and soil-test P was not observed.
- Figure 1 suggests that some fields with low soil P have excellent yields while others have low yields. This relationship may be explained as other analyses are completed.

*Effects of P on Crop Performance*

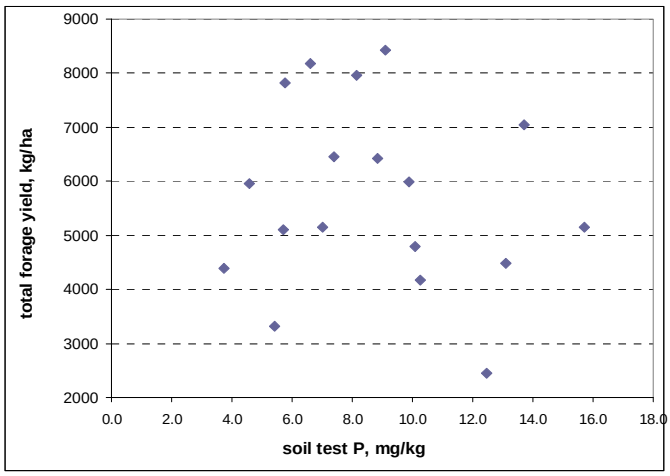


**Figure 1. Plot of Forage yield vs. soil P**

*Controlled Environment Experiments:*

- Soybean was grown in pots in two low-P soils from organic dairy farms. Soluble P was applied in various rates.
- The visible differences in soybean growth among P rates (Figure 2) suggest that P was a limiting factor in growth.
- Data from this trial is being analyzed.
- A similar trial will be conducted with alfalfa.
- A pot-trial will follow that examines the P-supplying power of organic amendments.

*Soil Biology*

- Experiments examining the role of soil biology on crop P uptake are in the planning phase.
- Studies will be included of mycorrhizae fungi.
- Mycorrhizae grow on crop roots, sending out many kilometres of tiny threads that help plants absorb soil phosphorus.

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## THE BOTTOM LINE

- Preliminary results reinforce the importance of legumes in organic forage crop productivity.
- Effects of soil P on forage productivity are not apparent from early data, but may emerge as more detailed analyses are completed.
- Further analyses and experiments are being conducted in 2009 and 2010.

## CREDITS

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