Cover Crops to Reduce Residual Soil Nitrate, Mitigate Greenhouse Gases and Boost Corn Production Efficiencies

(Interim Report)

Purpose:

This 3-year project was initiated in the late summer of 2003 to demonstrate and evaluate the growth potential of a range of cover crops, in manured and non-manured scenarios. Furthermore, the project is evaluating the potential uptake of soil residual nitrogen and fall applied manure nitrogen by the cover crops and the subsequent timing of N release for utilization by succeeding crops such that fertilizer N requirements can be reduced. The work will examine the ability of cover crops to improve N use efficiency in corn production with the concurrent benefit of reducing N_2O emissions from agricultural practices.

Methods:

The ability of various cover crop species to establish and sequester nitrogen remaining in the soil following cereal harvest was evaluated on eight sites located in Perth, Hamilton-Wentworth, and Oxford counties in 2005. On seven of the sites, manure was applied in mid-late August and the various fall seeded cover crop species were established within five days of manure application (with the exception of one site where the manure was applied several days after cover crop establishment), into both manured and non-manured plots at each site. At the eighth site, no manure was applied. The cover crop species evaluated at each site were combinations of Oats, Annual Ryegrass, Oilseed Radish, Peas, Buckwheat, and Red Clover. The red clover was present at two of the sites and was established by under-seeding into the cereal crop in early spring.

Soil N levels were evaluated shortly after manure application in the manured and non-manured, no cover plots only. About two months after manure application, in each of the cover crop treatments, soil N levels were evaluated again. At the end of October, tissue samples were taken from each cover crop and analyzed for plant N levels. Plant biomass of each cover crop was evaluated in late fall to determine the growth potentials of the various cover crops.

In the spring of 2006, soil N levels will be measured at corn planting and at sidedress timings. Corn will be planted at most of the sites and 2-4 rates of inorganic N applied to evaluate the ability of the cover crop to meet the subsequent corn crops needs for N.

Results:

The application of manure increased growth of each of the fall seeded cover crops. Where manure was applied, above-ground cover crop yield was increased by 35 to 45 percent (see Figure 1).

Manure not applied	Manure Applied

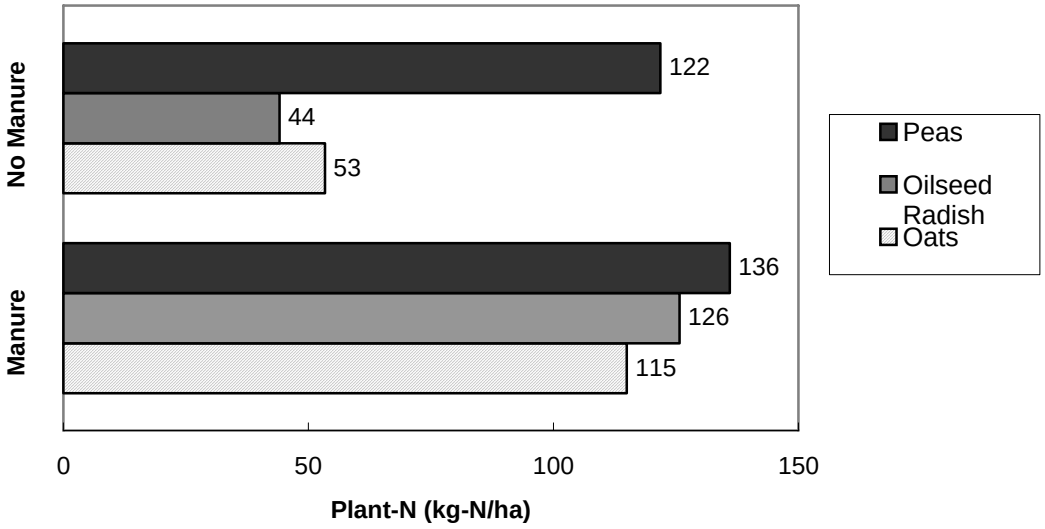
Figure 1. Oilseed radish growth at the Woodstock site. Manure (solid poultry at 3.8 tonnes per acre) was applied and incorporated with tandem disc. Cover crop planting date was August 10, picture taken October 3, 2006. (Photo: C. Brown, OMAFRA)

Where manure was applied, end of season Oat and Oilseed radish yield averaged about 4500 kg/ha whereas the pea and ryegrass yields averaged about 3300 kg/ha. Red clover growth was unaffected by manure application, with above ground yields by November reaching about 3000 kg/ha.

Each of the cover crops had greater nitrogen content in the above-ground biomass where manure was applied (Figure 2). The non-legume species (Oats, Ryegrass, and Oilseed Radish) accumulated about 40 to 70 kg/ha more nitrogen in above-ground biomass where manure was applied.

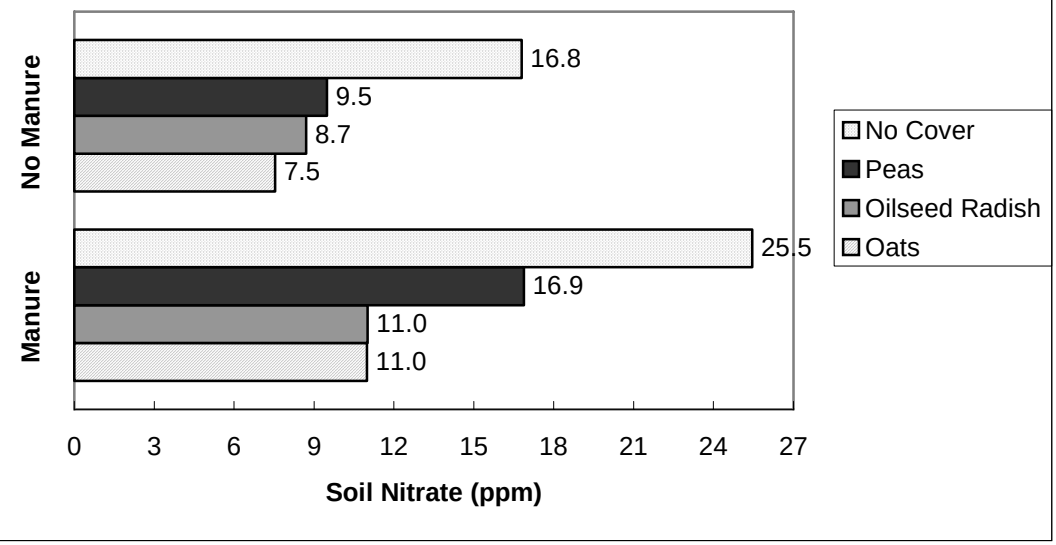
The legume species (Peas and Red Clover) also accumulated more nitrogen in above-ground biomass where manure was applied; but the differential was much smaller than the non-legume species; as one might expect due to their ability to fix atmospheric N when manure N is not available.

Figure 2. Total Plant-N for 7 Locations in Southwestern Ontario in 2005. Data from selected cover crops. Late October Harvest.



Generally in the No Cover area (control strips where cover crops were not established) soil nitrate concentrations were significantly lower than the no cover areas where manure was applied. The presence of cover crops in 2005 had a huge effect on the residual soil nitrate levels especially where manure was applied (see Figure 3).

Figure 3. Soil Nitrate Values (0-30cm depth) for 7 Locations in Southwestern Ontario. Data from late October sampling on selected treatments.



Summary:

Where manure had been applied, each of the three main cover crop species (Peas, Oilseed Radish, Oats) had more than 100 kg/ha of nitrogen in the above ground biomass. Most cover crop species have clearly demonstrated their ability to sequester nitrogen and to significantly lower soil nitrate residual values. This may reduce greenhouse gas emission potential. It should also be noted that August seeded peas in a cash crop scenario (i.e. no manure) appear to have significant N accumulation ability.

Although we are confident that August seeded cover crops can a significant impact in the fall (via cover crop biomass and soil nitrate) this study will move towards clarifying how much of this sequestered nitrogen can be efficiently relayed to the following corn crop.

Next Steps:

The economics, feasibility and systems approach to cover crop management including the impact on subsequent soil nitrogen status and corn crop growth will be studied in future cover crop work. Reliable N credits, similar to those we have for red clover, need to be developed for other cover crops both in a manure and non-manure environment.

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