Cover Crops for Carbon Sequestestration and Nitrogen Management in Field Crops – GHG Approaches.

(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 with the cover crops and the subsequent timing of N release for utilization by succeeding crops such that inorganic N requirements can be reduced. The work will reflect the ability of cover crops to improve N use efficiency in corn production with the concurrent benefit of reducing N2O emissions from agricultural practices.

Methods:

The ability of various cover crop species to establish and sequester soil nitrogen remaining following cereal harvest was evaluated on six sites located in Perth and Oxford counties in 2003. On five of the sites, manure was applied during the last week of August and the various fall seeded cover crop species were established during the first week of September into manured and non-manured plots at each site. The cover crop species evaluated at each site were combinations of Oats, Annual Ryegrass, Oilseed Radish, Peas and Red Clover. The red clover was present only at one of the sites and was established by underseeding into the cereal crop in early spring.

Soil N levels were evaluated prior to and 10 days following manure application and prior to freeze up in each of the cover crop treatments. Following November 1st, 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 2004, soil N levels were taken as close to spring thaw as practical and again in mid June. Corn was planted at most of the sites and 2-4 rates of inorganic N were applied to evaluate the ability of the cover crop to meet the subsequent corn crops needs for N.

Results:

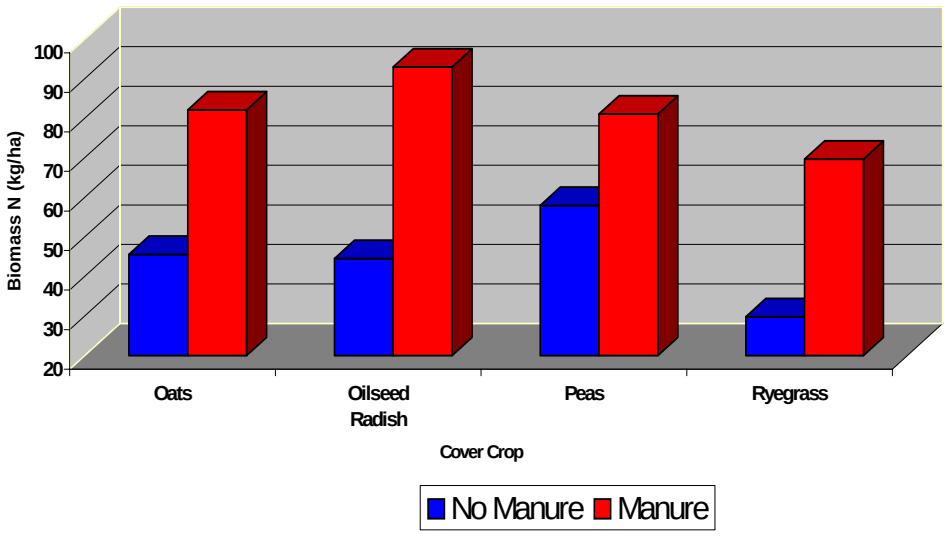
Application of manure increased growth of each of the fall seeded cover crops. Where manure was applied, above-ground cover crop yield was increased by 25 to 40 percent. Where manure was applied, end of season Oat and Oilseed radish yield averaged about 2500 kg/ha whereas the pea and ryegrass yields averaged about 1700 kg/ha. Red clover growth was unaffected by manure application, with above ground yields by November which were over 3000 kg/ha.

Each of the cover crops also had greater nitrogen content in above-ground biomass where manure was applied (Fig. 1). The non-legume species (Oats, Ryegrass, and Oilseed Radish) accumulated about 40 to 50 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 actual increase was only about half of the non-legume species (Red clover data not presented). The smaller increase in N content because of manure application associated with the legume species should not be interpreted as suggesting that they are less capable of sequestering soil (or manure) N. The smaller increase in N content of legume species is probably due to their ability to fix atmospheric N when soil (or manure) N is not available.

Soil mineral N (nitrate and ammonium) content in early November was usually not significantly affected by either manure or cover crop treatments. Generally in the No Cover area, (control strips, where manure was not applied and cover crops not established) soil mineral N concentrations were not more than 2 ppm lower compared to where manure was applied; this occurred in spite of application of significant rates of manure (e.g. 45,000 l/ha of liquid hog or 45 t/ha of solid cattle). The presence of cover crops marginally decreased November concentrations by up to 2 ppm (on average). In some situations the No Cover treatment was allowed to grow up in volunteer cereals and/or weeds. In these cases the overall impact of the seeded cover crop may have appeared greater if compared to strips that had been kept free of plant growth. The lack of measurable effect of cover crops on November mineral N content should not be interpreted as the cover crops failing to sequester N. October and early November had numerous, and significant, rainfall events which probably contributed to environmental

Figure 1. Total Nitrogen Sequestration in Above Ground Cover Crop Biomass



loss of soil and (or) manure N through either leaching and (or) conversion to gaseous N forms (including Greenhouse Gases).

Summary:

Where manure had been applied, each of the cover crop species had ~ 80 to 95 kg/ha of nitrogen in the above ground biomass. he average increase in above-ground N content was ~ 20 to 25 kg/ha for the legume species and 40 to 50 kg/ha for the non-legume species. Assuming that N yield in cover crop roots was also increased by manure application, it is reasonable to assume that 40 to 60 kg-N/ha of manure N was

sequestered by the various cover crop species evaluated. Therefore, the cover crop species evaluated demonstrated an ability to potentially reduce Greenhouse Gases since they clearly tied up 40 to 60 kg/ha of soil and (or) manure N which was potentially subject to some form of environmental loss.

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 further detail in the remaining years of this project.

Acknowledgements:

OMAF Field Crop Technology would like to acknowledge the farm cooperators who made land and other resources available for conducting these projects. The partnership with the Cropping Systems Laboratory of the Plant Ag. Department of the University of Guelph has been instrumental in the success of the project to date. Funding for the project has been provided by the Greenhouse Gas Mitigation Project for Canadian Agriculture supported by AAFC in conjunction with OSCIA, IFAO and others.

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Location of Project Final Report: