Advancing Nitrogen Use Efficiency on Livestock Farms – GHG Reduction Approaches

(Interim Report)

Purpose:

This project was initiated to demonstrate best management practices associated with maximizing nitrogen use efficiency on farms having a history of manure use and thus potentially reduce the levels of GHG emissions by matching corn N requirements to the N supplying capability of the manure containing production system. Tools to be evaluated and demonstrated include the soil nitrate N test for determining corn nitrogen requirements and the end of season corn stalk N test as an indicator of nitrogen sufficiency for the recent corn crop.

Methods:

Ten sites were established across the livestock intensive regions of Ontario including Bruce/Grey/Huron, Central and Eastern Ontario. Farms were selected from a number of livestock types including dairy, beef, swine and poultry. The fields chosen required a history of receiving manure. Where no manure test was available, no manure application to the site in the previous year was required. Some sites had a recent manure analysis and fields with applications the previous year were accepted. Fields were chosen where clearly identifiable zones within the field could be distinguished including knolls, depressions, slopes etc.

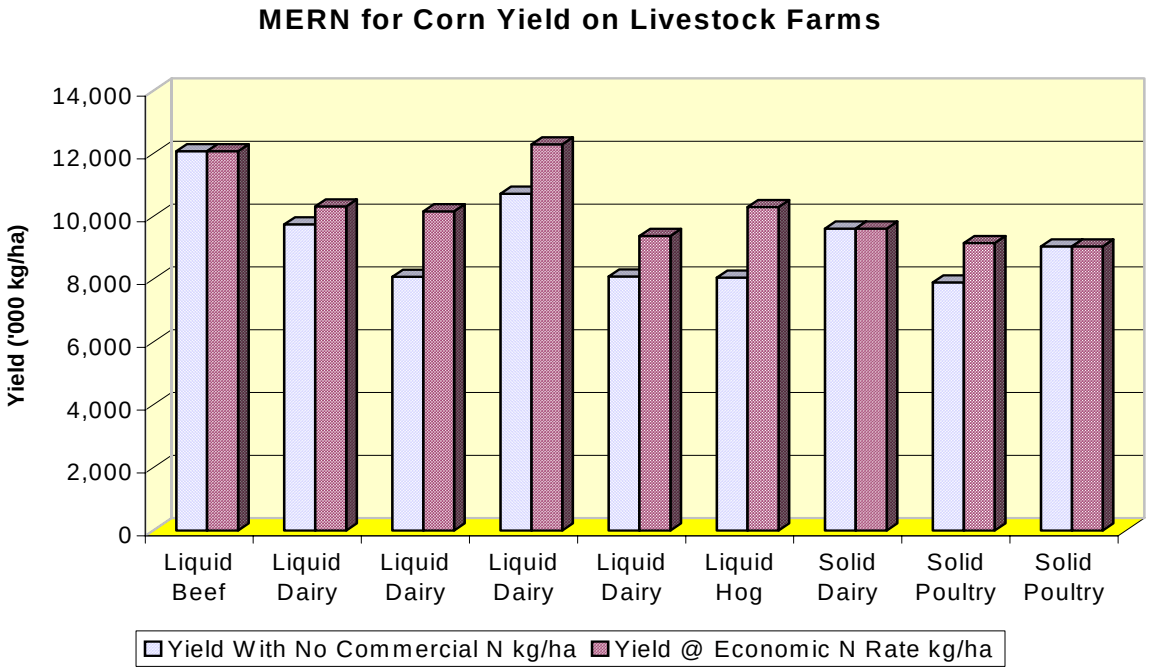
Growers were encouraged to recommend fields where manure application had occurred uniformly and where the area had the same field history of cropping and inputs.

Four rates of fertilizer N (0, 50, 100, and 150 lbs./ac) were established by sidedressing the appropriate rate of U.A.N (28%) sometime during the latter part of June. The yields from the various fertilizer N strips were used to estimate the most economic N rate (MERN). Within plots for the 0 and 100 lb./ac N rates, 3 benchmarks were established from which soil sampling would occur at preplant, and side dress timings. Benchmarks were located in obvious distinct zones that crossed the plot area. At maturity soil N samples were collected from benchmark positions in all plots. Additionally, samples of corn stalks were taken according the to the protocol for the “lower stalk N test” to estimate the sufficiency of the earlier season N applications to meeting crop needs.

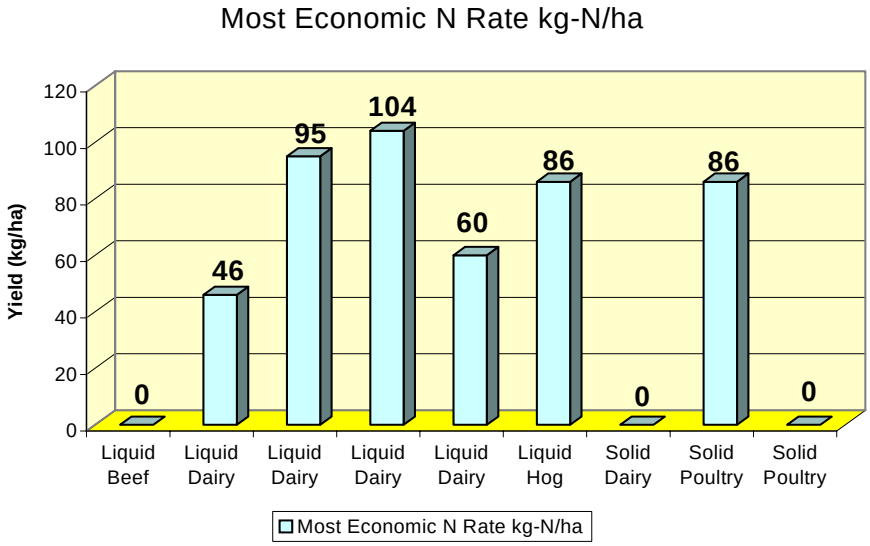
In the following spring the benchmarks were also sampled at thaw for estimating GHG losses.

Results:

Corn yields at each of the nine sites were relatively high, with yields at the most economic N rate ranging between 9000 to 12000 kg/ha (140 to 190 bu/ac) (Table 4). In fact, yields rarely were less than 8000 kg/ha (127 bu/ac) even where sidedress fertilizer N was not applied; ranging from a low of 7900 kg/ha (125 bu/ac) to 12000 kg/ha (191 bu/ac).

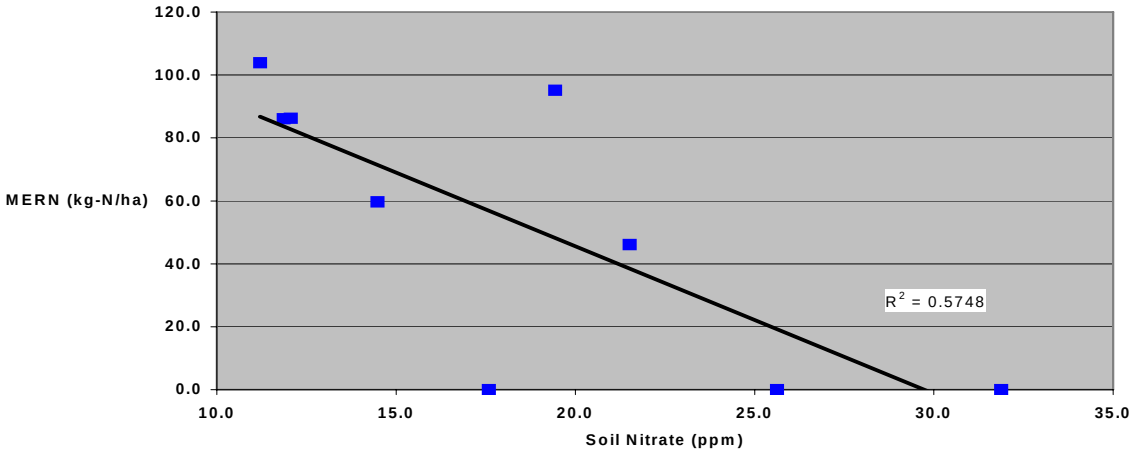


The estimated most economic N rate (MERN) did not exceed 105 kg-N/ha (95lb-N/ac) on any of the nine demonstration sites (Table 4). Three of the nine sites actually did not require any sidedress fertilizer N to achieve most economic yields.



Spring soil nitrate concentrations in the surface 30 cm (1 foot) in late May (May 20 to May 31) ranged from 11 to 32 ppm (Fig. 6). There was a relatively clear relationship between spring soil nitrate-N concentrations observed in late May and most economic N rates. At about 11 to 15 ppm about 70 to 100 kg/ha (65 to 90 lb-N/ac) of fertilizer N was required. As soil nitrate-N concentrations increased, fertilizer N required to achieve most economic yields decreased to 0 once soil nitrate-N concentrations exceeded about 25 ppm.

Figure 6. Relationship Between Site MERN and Spring Soil Nitrate Values



Summary:

In the first year of this 3-year study, the results suggest that relatively high corn yields can be produced with relatively low (or no) fertilizer N when grown on fields where manure had been recently applied. There was a clear relationship between late May soil nitrate-N concentration and the fertilizer N rate required to produce the most economic yield; supporting the idea that a N test can be utilized to predict the need (and perhaps amount) of fertilizer N for corn grown on fields where manure had been recently applied. A properly calibrated soil nitrate-N test will not only improve economic returns of corn grown where manure was recently applied; but also will reduce the quantity of soil mineral N remaining at the end of the growing season. This will minimize the likelihood of soil N loss to the environment, including minimizing the production of Greenhouse Gasses.

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.

Project Contacts:

Greg Stewart, OMAFRA, Guelph, greg.stewart1@ontario.ca
Brian Hall, OMAFRA, Stratford, brian.hall@ontario.ca