Nova Scotia Agricultural College

Soil & Crop Improvement Association of Nova Scotia

factsheet

NITROGEN FERTILIZATION BASED ON PRE-PLANT SOIL NITROGEN TESTING (PPNT) FOR GRAIN AND PRE-SIDEDRESS SOIL NITROGEN TESTING (PSNT) FOR CORN

NITROGEN MANAGEMENT

Nitrogen (N) is essential for producing a successful, high yielding crop. Excessive N applications are costly to farm operations and may impose detrimental health and environmental problems, especially when nitrate (NO_3) is leached to groundwater reserves. As well, the release of nitrous oxide (N_2O), the major greenhouse gas emitted from the agricultural industry, is directly proportional to the amount of N fertilizer applied.

In many parts of the world, soil NO_3 testing is used to match fertilizer application with plant needs. This results in reduced costs and decreased release of N_2O into the environment.

In Nova Scotia, N fertilizer recommendations are not based on soil testing but rather on estimated plant-N demand. On-farm soil N testing can provide site-specific information on N availability, allowing recommendations to be modified to reflect local soil conditions and/or management practices. This is particularly important on farms where significant amounts of manure are routinely applied.

SOIL NITRATE TESTING

The Soil & Crop Improvement Association of Nova Scotia's Greenhouse Gas Mitigation Program (GHGMP) has given producers the opportunity to examine soil NO_3 testing as a means to increase the efficiency of N fertilization, and in turn reduce N_2O emissions.

Adoption and use of pre-plant soil N test (PPNT) for grain, or the pre-sidedress soil N test (PSNT) for corn, to predict N requirements is of great value to both producers and the environment, and is the anticipated outcome of the GHGMP.

To utilize this test, the following routine should be carried out:

(i) Sample soil one week before seeding (for grain) or one week before sixth-leaf side-dress N application (for corn).

(ii) Submit the sample for analysis to detect the amount of plant-available N present.

(iii) Use results to determine the actual rate of N fertilizer to be applied. From the recommended N rate (for grain or corn), subtract the N-value of manure applied over the past year. From this value, subtract the value of plant-available N determined from the PPNT/ PSNT test.

DEMONSTRATION SITES

The GHGMP, currently in its second year of operation, involves the demonstration of these tests on farms throughout Nova Scotia. Two sites examine grain production and three examine corn production, and are located in the eastern, central and western regions of the province.

Four treatments are considered at each site as a percentage of the total recommended N applied:

(i) 0% (as a control)

(ii) rates of 25%, (iii) 50% and (iv) 100%

Fig. 1. Demonstration of a PPNT for grain (left) and PSNT for corn.

Soil and GHG Sampling

Soil samples are obtained (30 cm depth) prior to planting and/or fertilization, and bi-weekly throughout the growing season. A post-harvest soil analysis is completed to determine excess N in the soil. Climatic information, crop yield, crude protein content and thousand-kernel weight were recorded at each site where appropriate. The production of N_2O is measured at the same time as soil sampling, in order to gain a better understanding of emissions during the growing season.

Fig. 2. Sampling technique for GHG emissions.

Yield Results

The results from 2003 indicated that sites receiving little or no manure experienced increased yields with larger applications of N fertilizer (Fig. 3: Western Region). The Eastern Region site which received two manure applications per year showed no significant differences in yield.

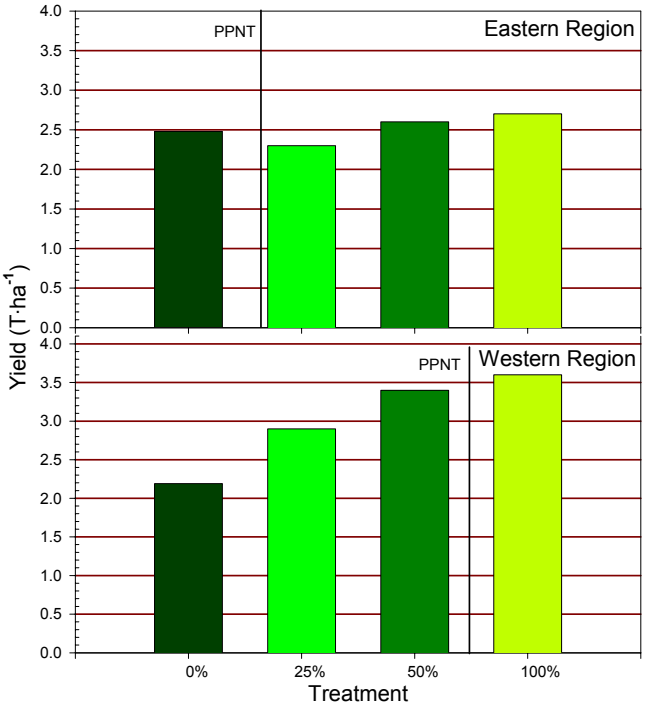

Fig. 3. PPNT demonstration for barley (Eastern Region) and spring wheat (Western Region) yield.

Greenhouse Gas Emission Results

Similar to the yield response, emitted N_2O increased when N fertilizer was supplied at levels sufficient to meet crop N requirements (Fig. 4). At the site receiving two manure applications, N_2O emissions peaked at the level corresponding to the crop N requirement; fluxes as high as 62 g N_2O-N·ha^{-1}·d^{-1} were observed. However, at the sites where yields increased with increasing N applied, N_2O fluxes remained low. When N fertilizer was applied in excess of crop requirements (> 50% recommended rate), higher N_2O fluxes were observed. Therefore, if crop requirements are met, the excess N is lost to the atmosphere or groundwater.

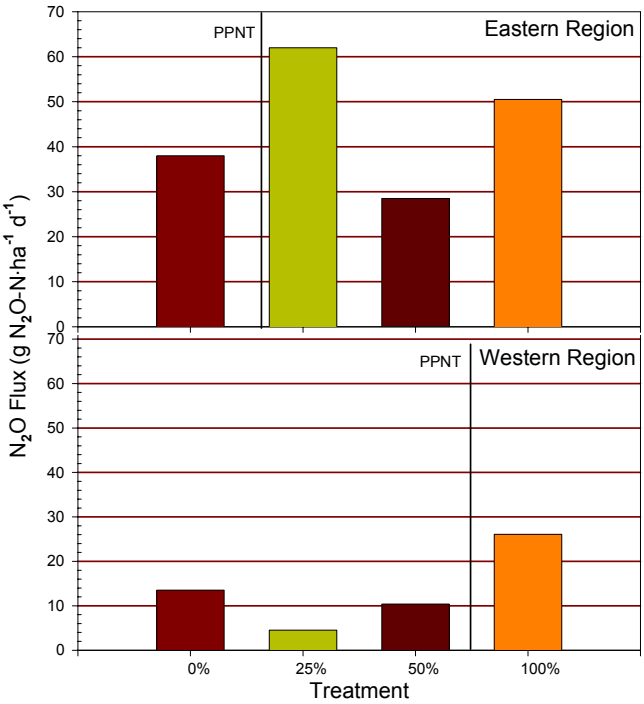

Fig. 4. PPNT demonstration for barley (Eastern region) and spring wheat (Western region) peak N_2O emissions.

Conclusion

Utilizing a soil N test will help to avoid the application of excessive amounts of N fertilizer. This will improve farm profitability by using lower amounts of N fertilizer, and will subsequently limit the potential of detrimental environmental impacts.

The GHGMP is being conducted with support of:

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