Site Specific Farming: The Next Level

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In the last 30 years, the nitrogen (N) usage on the Canadian prairies has increased steadily. With each new decade, we also saw the introduction of a new fertilizer management and application methods for Nitrogen N. The 70's was broadcasting, the 80's Banding, and the 90's seed placement. As we enter the 21st century, we can observe changes on the horizon. With the high cost of N, low commodity prices, variable weather conditions and tight cash flows, producers are busy rethinking their N management strategies with the goal of increasing their nitrogen use efficiency (NUE). When these factors are combined with the environmental pressures being imposed on producers, it becomes even more critical to answer the when, where, how and how much for nitrogen fertilizers.

Nitrogen Use Efficiency (NUE), worldwide is approximately 33%, common sense tells us that this number is far too low. With the recent increases in the price of nitrogen fertilizer we must learn to become more efficient with this very valuable crop input.

One of the solutions to these problems appears to be in varying the rate of nitrogen fertilizer, placing it where it will do the crop the most good. There are two types of variability that are of concern to producers. The first one is temporal variability which is related to the yearly variations in growing conditions (temperature, moisture, heat) which directly influences crop growth, nutrient uptake and the amount of nutrients left behind for the subsequent crop.The second is spatial variability which is the function of changes, over short distances, in chemical and physical soil properties which is greatly affected by changes in landscape.

Soil Nutrient availability has traditionally been determined through soil sampling and subsequent chemical analyses e.g. Residual soil NO_3 –N. However, use of coarse resolutions encompassing large areas of land cannot provide reliable information on the spatial variability and the nutrient availability within the field. Research evaluating spatial variability using grid sampling for field maps indicated that variation in soil nitrate-N occurred over short distances (less than 3'). This makes grid soil sampling at the correct scale prohibitive in both time and cost. Research at Indian Head, Sask. comparing long-term and short-term no-till fields, has also shown that the capacity of soils to supply nitrogen can vary dramatically. The rate of N mineralization was considerably higher on the long term not-till seeded fields This in turn reduces greatly the usefulness of residual soil nitrate N soil tests as they are not capable of estimating the N releasing power of the soil.

Yield mapping, with a combine yield monitor can provide us with the overall spatial variability of a field. It does give us a precise picture of the crop harvested, however this is dealing in the past and can not address the extent of change from one year to the next, making efficient nitrogen management difficult.

Remote sensing using satellite imagery has also been used to sense spatial variability within growing fields.
For example, Land Sat 7, is capable of resolution to 15m. The problem associated with this satellite, is it has a 16 day repeat cycle, so if the day it passes over your fields it is cloudy, you would not have an opportunity for another 16 days to gather information, assuming that it is not cloudy on this subsequent pass. This is not acceptable with the narrow growing windows we are working with for fertilizer applications.

More recent satellites Ikonos and Quick Bird, have 1meter and sub meter resolution. However, is this resolution high enough to capture the spatial variability? The issue of real-time for in-season application still remains.

Recent developments in weather forecasting and crop modeling have driven the development of new technologies for predicting grain yield, thus allowing for in-season adjustments of N.

A new technology that has recently entered the Canadian market is the GreenSeeker™.
This variable rate application system optically senses plant nutrient needs and variably applies fertilizer to match those needs. In simple terms, The GreenSeeker™ sensors give the crop a physical, write prescription and deliver the optimal amount of fertilizer in fractions of seconds as the applicator travels across the field. It talks to the plant instead of the soil, verifies the amount of N the soil has made available to that point and then varies the application rate in real time. It predicts yield potential for the crop using Normalized Difference Vegetative Index (NDVI). The nitrogen recommendation is then based on in season yield potential and the responsiveness of the crop to additional N.
A nitrogen rich strip, placed earlier in the season is used as the benchmark.
The use of active sensors equipped with an internal light source, allows the system to operate in cloudy weather, day or night.
The system can be attached to most high clearance or liquid dribble applicators.
Six sensors are attached to the front side of the boom, each sensor reads its appropriate area, sends this information to the rate controller, where the information is averaged.
As a result the fertilizer rate is varied with the forward travel, but is not varied over the width of the boom

The GeenSeeker™ , which will be available for the spring of 2005, will sell for approximately $15,000.00 Can$.