FIELD EVALUATIONS OF NITROGEN RAMP CALIBRATION STRIPS IN MANITOBA

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Abstract

Nitrogen Rate Calibration Strips (NRCS) were demonstrated in some 30 farm fields of cereals, corn and canola. Mid-season assessments of crop yield sufficiency were useful in estimating the adequacy of nitrogen (N) supply. For cereals, relative plant height provided a simple and quick indicator of N sufficiency. This NRCS technique has been used to demonstrate the provincial N rate calculator in extension and has been adapted for P demonstrations in alfalfa.

Introduction

Nitrogen (N) use and rates are constantly reviewed since it is an expensive put and under environmental scrutiny. There is growing interest in methods and techniques that may allow growers to improve efficiency of N and refine applied rates.

Oklahoma State University has proposed and developed an in-field technique for assessment of appropriate N rates for high N use crops, called the Nitrogen Ramp Calibration Strip (NRCS) (Raun et al, 2008). The system involves visual assessment of plots with incremental rates of N applied at or shortly after seeding to identify the N rate required for maximum forage production. The lowest N rate yielding the maximum mid-season forage production (determined visually or with sensors) provides an estimate of additional N required to achieve optimum grain yield.

Options for mid-season N application for yield are limited in our short growing season but we wished to demonstrate NRCS in extension to:

- quantify N replacement value of manure applications or legume contributions
- determine if N credits being granted to manure or previous legumes were sufficient to optimize yield
- quantify losses of N due to excessive rainfall, etc.
- assess the appropriateness of current N fertilization strategies, including zone N management and N reductions due to economics

Approach

N Ramp Calibration Strips were imposed in 22 cereal fields, 4 canola fields and 4 corn fields. In some instances N was applied to fields with a base rate of applied N from previous fertilizer or manure applications. In other instances the ramps were located in areas of the field without applied N.

Usually nitrogen was hand applied as Agrotain treated urea after crop emergence in May. Ideally application would be done earlier, but this timing allows selection of a strip area with uniform crop stand.

The NRCS is basically an unreplicated, unrandomized N response strip applied in a longitudinal plot with increasing N rates. In most instances the cell dimensions were 10' x 10' (3m x 3m) with nitrogen applied in 10-30 lb N/ac increments.

At sites we employed several of the numerous observations available for estimation of in-season crop N status or yield potential, including: early season biomass, plant height, N tissue concentration, SPAD chlorophyll readings, leaf and plot colour (Witt et al, 2005), the pre-sidedress nitrate soil test and NDVI (normalized difference vegetation index). Nitrogen sufficiency measures that can be made after harvest were also demonstrated including: corn stalk nitrate, wheat grain protein and post harvest soil nitrate levels.

Several of these above measures have established critical or sufficiency levels, whereas others depend on some relative measure compared to a high non-N limiting treatments (biomass, height, SPAD, leaf and plot colour). Where established criteria were not found, these indicators were presumed sufficient if within 90-95% of the maximum observed reading.

In practice the strips are assessed mid-season with no further observations, but to evaluate this technique, the ramp cells were harvested for grain yield.

Results

Ramp strips were simple and quick to implement. It took 18-20 minutes from site selection to complete staking and hand N application. Observations of N status and yield sufficiency took longer than imposing the ramp

In several instances ramps were located on headlands, which are probably atypical of whole field N status. Ramps should be located in representative areas of the field – similar to those areas selected for benchmark soil sampling

Sample responses and method of reporting for extension is illustrated in Figures 1-2. At a highly N responsive site (Figure 1) all the observed factors increased with N rate in step with final yield. In contrast at a less-N responsive site, observed measurements increased only slightly with N rates.

The N rate estimated to produce high yield (> 90% of maximum) based on in-field observations was compared to the N rate producing harvested yields >90% of maximum. The results from 11 cereal fields are summarized in Table 1.

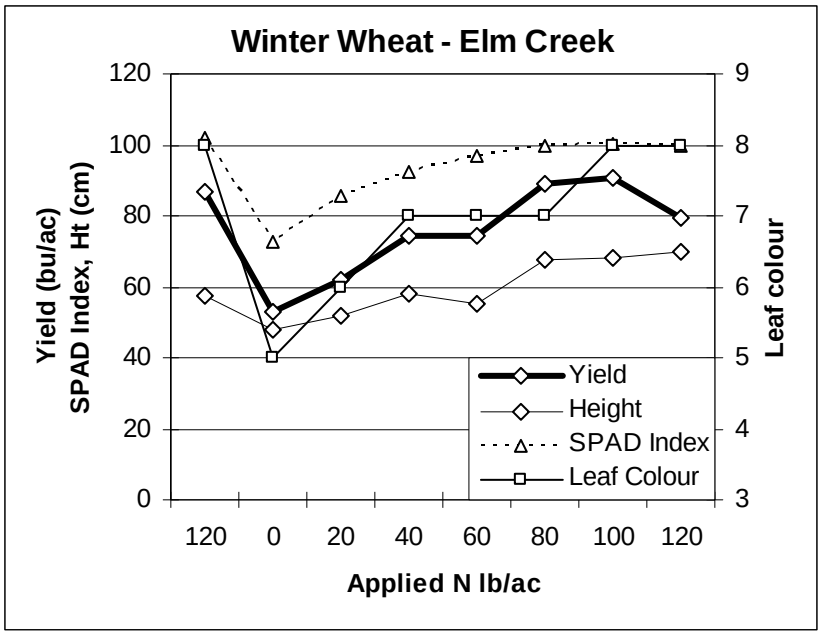

Figure 1. Plotting of selected N ramp observations with grain yield on a highly N responsive site.

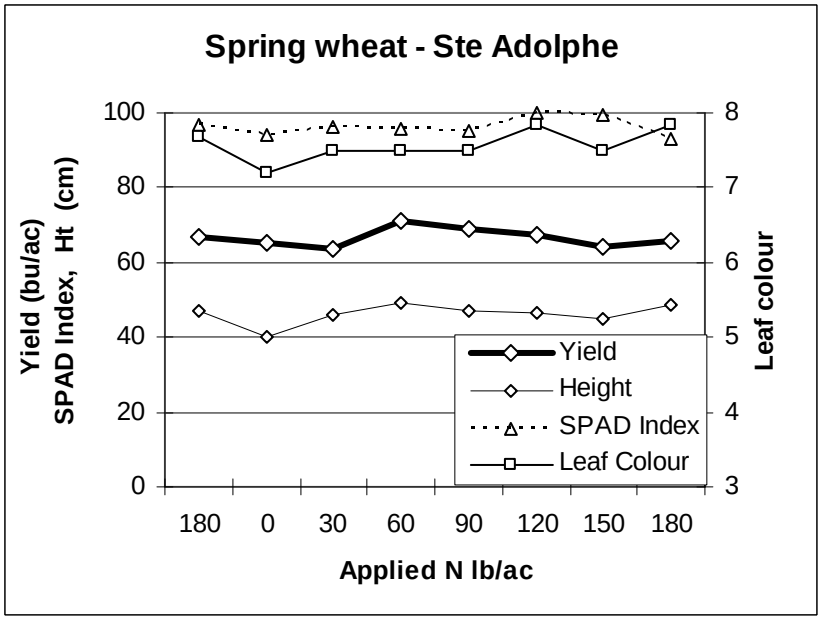

Figure 2. Plotting of some N ramp observations with grain yield on a site less responsive to N.

Table 1.Ability of in-season observations to detect yield sufficiency in cereals.

	Portion of observations identifying sufficiency			
Deviation from N rate for yield sufficiency (lb N/ac)	SPAD Index	Plant height	Leaf colour	NDVI
0	36%	42%	36%	45%
+/-10	45%	42%	36%	45%
+/-20	55%	75%	64%	55%
+/-30	73%	92%	73%	73%
+/-40	91%	100%	91%	91%
+/-50	100%	100%	100%	100%

The observations of relative plant height, SPAD Index, leaf colour and NDVI were reasonably accurate in identifying N sufficiency related to final. Surprisingly, the least expensive and simplest to measure observation, relative plant height, was the most effective.

For extension purposes these ramp strips and provided a valuable backdrop in introducing our new provincial N recommendations based on soil N and crop/fertilizer price economics.

Summary

Through field testing the Nitrogen Ramp Calibration Strip technique we have learned:

- strips are quick and easy to apply but care should be used in selecting the site
- It is suggested that 2 strips per field be used in order to account for variability and possible grower misapplications into the area.
- A number of N sufficiency or biomass measurements can be used to assess the rate of N required to optimize yield. One of the best was simply relative plant height.

We've found these N strips useful in assessing crop N sufficiency where:

- N supply is uncertain from applied manure or plowdown legume crops
- Where N losses have occurred due to leaching and denitrification
- Where growers have applied insufficient N rates in overreaction to high N costs

Extension colleagues have adapted this strip technique in grower's forage fields to demonstrate the importance of phosphorus for yield, forage quality and stand persistence.

References

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