A Summary of Western Ag's Fall 2008 Field Soil Testing Results.

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Abstract

Since 1998 Prairie farmers have had available an innovative decision support tool in the PRS™ Technology. Crop nutrition plans are generated that recognize the unique characteristics of the field's soil nutrient supply rate and acknowledges the economic risk tolerance of the individual farmer. Though provincial soil test results are not useful to an individual, the monitoring of yearly data over time will give indications of "average" soil nutrient supply changes over time. Year to year differences can also provide the fertilizer industry signals of anticipated demand.

Introduction

The business of farming can be quite challenging even at the best of times. Pressures from fluctuating commodity markets, input costs and Mother Nature are interpreted and acted on in a balance that is unique to each individual farmer.

Since 1998, an innovative tool has been available to the Prairie farmer for crop nutrition planning. It is PRS™ Technology. The technology has two components, PRS™ (Plant Root Simulator) Probes and the PRS™ Nutrient Forecaster. The PRS™ Probe is a soil analysis technology (Fig. 1) utilizing ion exchange resins that measure, not the concentration of soil nutrients, but their plant available supply rate. The probes were patented in 1991 for the University of Saskatchewan by Dr. Jeff Schoenau, Professor and Researcher at the College of Agriculture and Bioresources. The PRS™ Nutrient Forecaster was developed to be a decision support tool for farmers in crop selection and crop nutrition planning (Fig. 2). The Forecaster is a constrained-resource mechanistic model. It integrates the raw data generated by the PRS™ probes with soil and plant characteristics influencing nutrient availability (soil clay content, soil density, pH, EC, available moisture, growing season temperature, and specific rooting characteristics) and marries this to the economics of farm specific fertilizer costs and new crop price expectations.

Figure 1. PRS™ Probes inserted directly into a moist field soil.

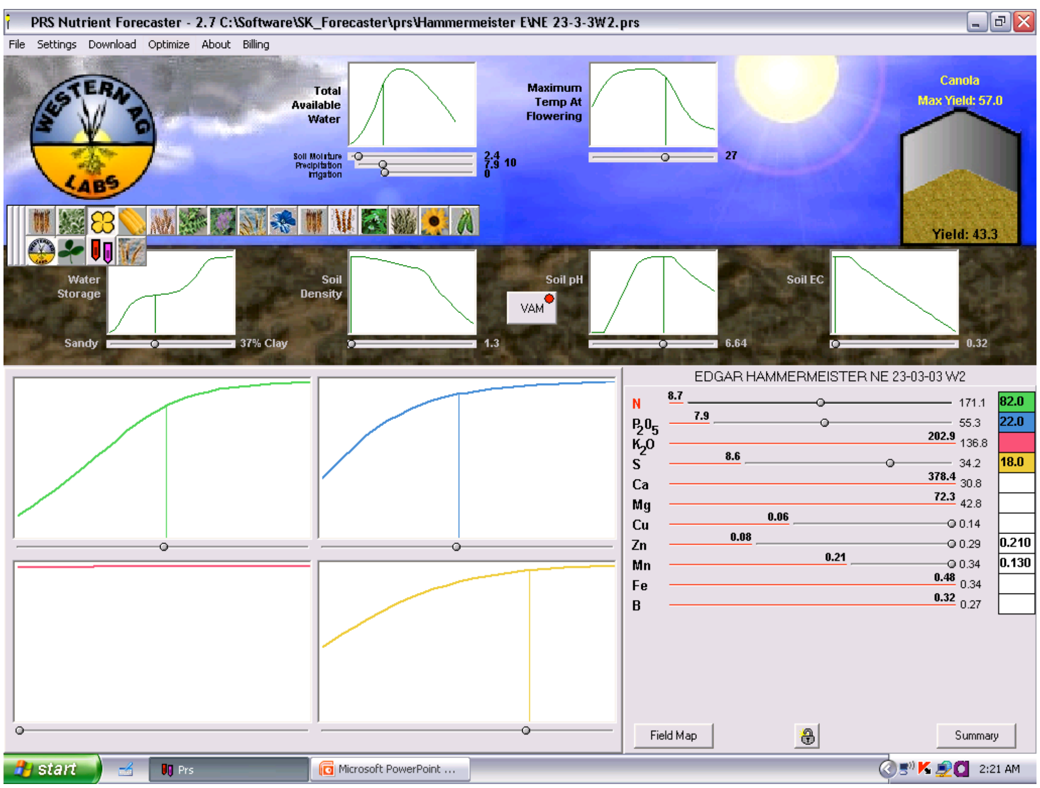

Figure 2. The PRS™ Nutrient Forecaster.

Method

For brevity, the evolution of the PRS™ Technology can be reviewed in Greer et.al. (2003). Hangs et.al. (2002) explains the laboratory analysis methodology and the Quality Assurance/Control.

In the field, composite soil samples are collected that focus on approximately the top 10 cm of the soil profile. The focus on the shallow depth considers where the greatest concentration of organic matter exists, where the early nutrient uptake activity occurs, and avoids the more calcareous B & C horizons. Second depth sampling (to 20-30 cm), is practiced on summerfallow and manure applied fields. The analysis is for N only (nitrate and ammonium). The number of sampling points varies by field size but typically range from 4 to 6 points of paired samples (both sides of the truck). The reduced number of sampling points is offset by receiving field history information from the land manager/owner prior to going to the field. Sampling equipment simply includes an appropriate shovel, trowel and sample containers. The simplicity in the sampling technique allows for immediate inspection of sample quality. Samples are then shipped to the Saskatoon lab for analysis.

Results

Prior to discussing the 2008 fall results, it would be valuable to set some context to the data presented. The growing season in Saskatchewan began in many areas with poor seed bed conditions. Limitations in soil moisture and/or soil temperature severely impacted crop establishment in many areas. However, as the growing season progressed, the growing crops were free from many common stresses of moisture, leaf disease and pests. That, combined with an extended frost free fall, allowed provincial crop yields to reach significant levels in many areas.

It can be anticipated then that with heavy crop yields, that nutrient uptake and export in seed was significant as well. Shown in Figures 3-6 are a comparison of provincial nutrient supply rates between 2008 and 2007. The measured data is presented as a nutrient flux per unit surface area per time (i.e. $\mu g/10\ cm^2/24\ h$). The supply rates circled on the x-axis represent approximate levels to which fertilizer recommendations begin to be considered within the Forecaster model.

Nitrogen (N) supply rates are demonstrated to be significantly lower in 2008 relative to 2007 (Fig. 3). The large, late crop certainly created a draw down in soil N supply power.

Phosphate (P) supply rates between years look remarkably similar (Fig. 4). In reality, this should not be as surprising as the nutrient dynamics are quite different for P. Though a significant amount of P is exported in the crop seed each year, and significant amounts of P fertilizer are typically applied, the majority of seed P comes from the soil. In essence, the soil is like a rolling bank account and therefore large fluctuations in soil supply P are not as prevalent between years.

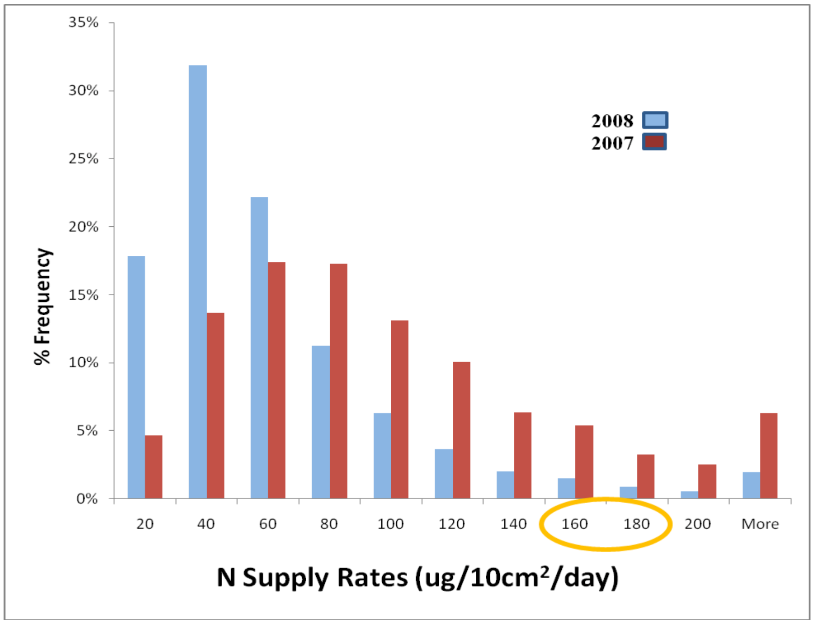

Figure 3. 2008 vs 2007 N Supply Rates.

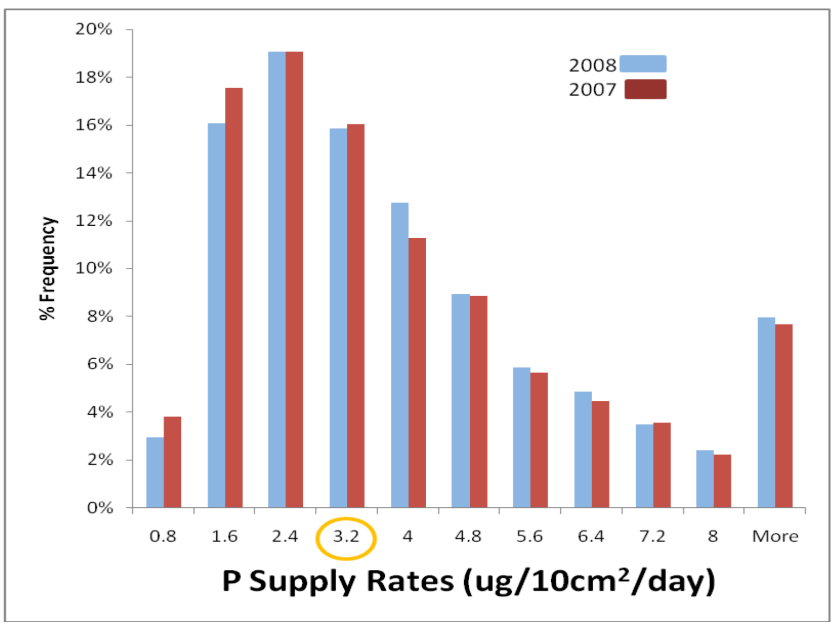

Figure 4. 2008 vs 2007 P Supply Rates.

The soil supply rate of Potassium (K) (Fig. 5) also shows a similarity between years. The significance here is that the majority of K taken up by crops is returned to the soil in the straw produced. Because of this, K supply rates also would vary less between years.

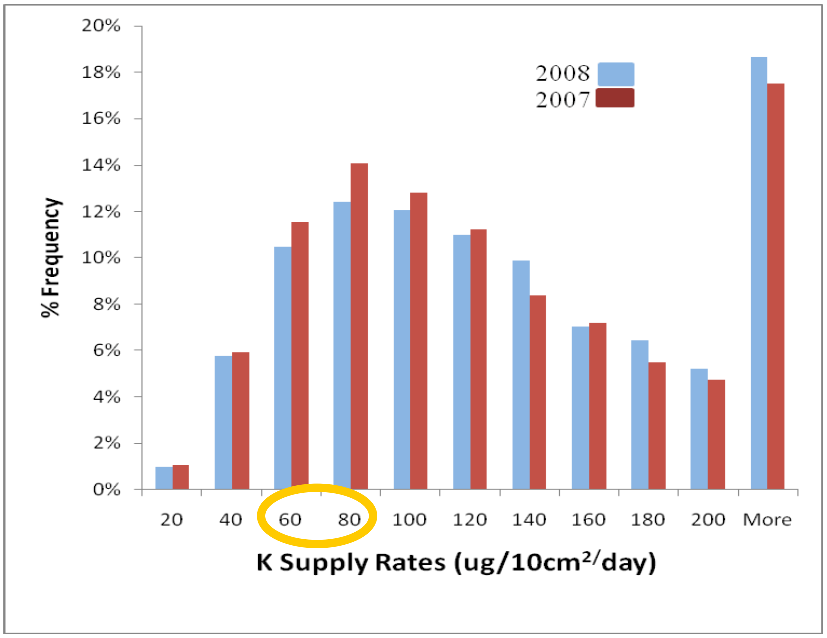

Figure 5. 2008 vs 2007 K Supply Rates.

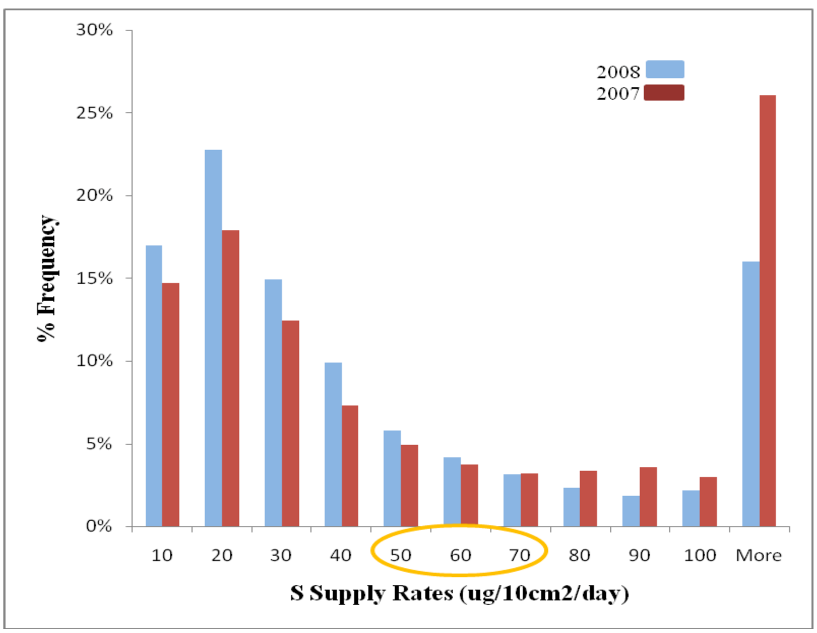

Figure 6. 2008 vs 2007 S Supply Rates.

Sulfur supply rates (Fig. 6) showed a slight depletion relative to 2007. Sulphate S levels are extremely variable across a field due to changes in parent material, organic matter and salinity.

Figure 7 is a compilation of nutrient supply rates from a field in SE Saskatchewan as determined by the target crop. The PRS^{TM} Nutrient Forecaster held the soil characteristics (clay content, pH, EC), total available moisture (9.5” or 238 mm), and Growing Degree Days constant between crops. The exception is canola which uses maximum temperature during flowering as one of its yield influencing factors. The bold number parallel to the nutrient represents the nutrient supply rate in “lbs/ac actual” to that crop. The Forecaster interprets the lab data in a mechanistic, constrained resource model that is specific to each crop.

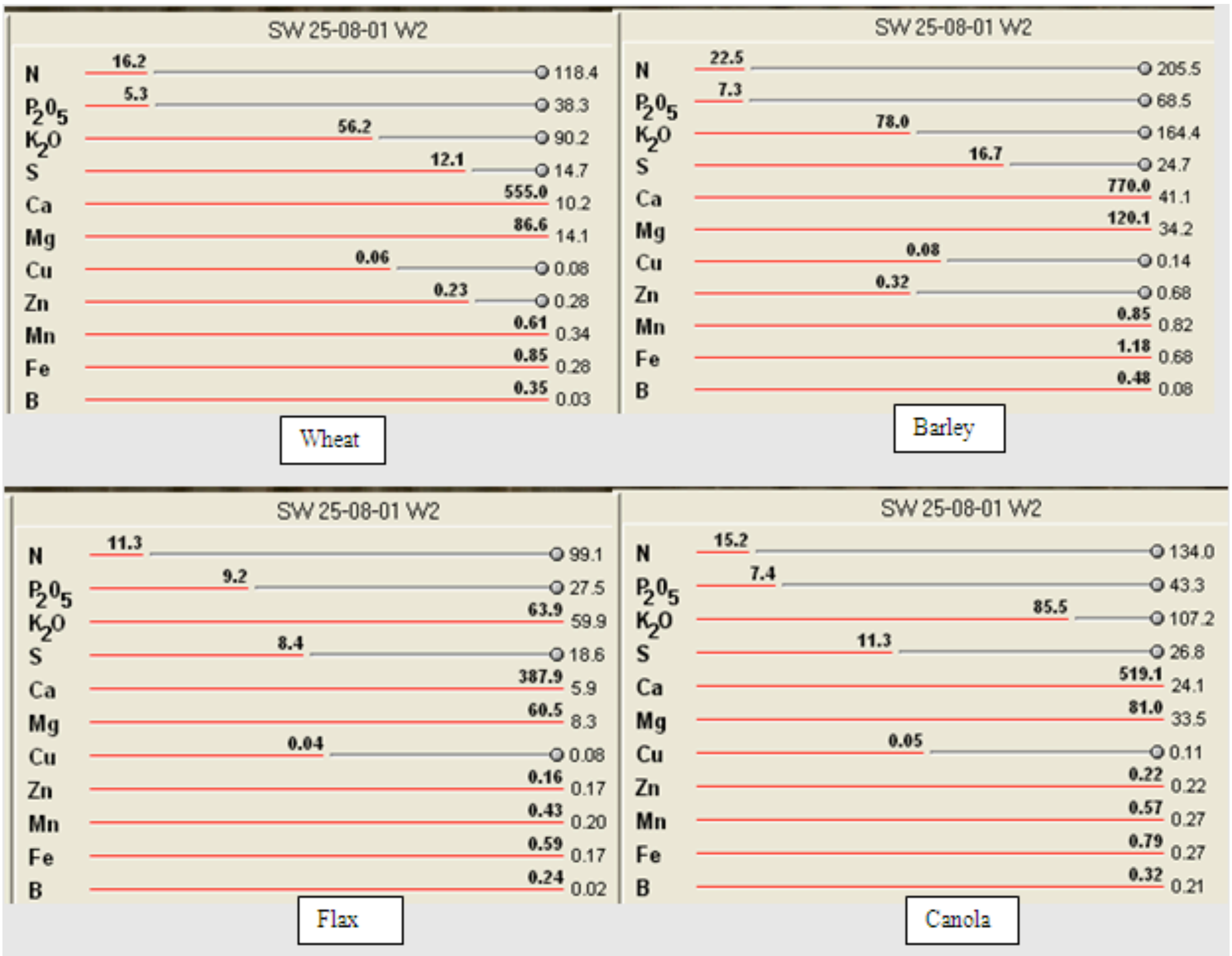

Figure 7. Soil nutrient supply rates for Wheat, Barley, Flax, and Canola in a field from SE Saskatchewan.

Measuring varying nutrient supply rates is only 1/3 of the process in formulating a crop nutrition plan. Plant nutrient demand and marginal return economics compose the other 2/3. Table 1 provides a summary of information a farmer would use in his crop planning process. The “net income” indicated represents “Gross less fertilizer costs” only. The farmer would then consider all the other costs of production related to that specific crop and would then compare his/her options. Further considerations relate to the farmer’s personal risk tolerance. A particular crop may show an economic advantage to another, but the investment in fertilizer may be outside the individual’s comfort zone and so an alternative crop would be considered.

Table 1. Plant Demand by Marginal Return Economics for Four Crops for a Field (SW 25-8-1 W2) in SE Saskatchewan.

	Wheat	Malt Barley	Flax	Canola
Crop Price $/bu	6.00	4.00	10.50	9.00
Fertilizer Budget $/ac	52.00	73.80	39.25	60.05
Forecasted Yield bu/ac	46	87	28	37
Net income $/ac	222.00	274.36	261.20	292.41
Fertilizer Blend Lb Actual/ac	68-16-0-0	68-30-20-0	50-10-0-5	70-20-0-9

Assumptions: Total Moisture 9.5" (238 mm), Clay 37%, Soil Density 1.325, pH 7.04, EC 0.32, GDD 1595, Max Temperature during Flowering 28°C. Fertilizer Costs $/lb N 0.60, P 0.70, K 0.60, S 0.45.

Conclusions

Though the data presented is not useful to develop individual field crop nutrition plans, monitoring yearly data over time will give indications of "average" soil nutrient supply changes over time. Year to year differences can also provide the fertilizer industry signals of anticipated demand.

The PRS™ Technology has proven over ten years of grower experience to be a useful decision support tool that optimizes economic crop yield while catering to the individual farmers risk tolerance.

References

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