A Summary of Fall 2011 Saskatchewan Soil Nutrient Supply.

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Key Words: PRS™ probes, PRS™ technology, ion exchange membrane, Saskatchewan 2011 soil nutrient analysis results.

Abstract

The reporting of regional or provincial soil test summaries has varying degrees of value depending on the individual using the data. The monitoring of yearly data will give indications of "average" soil nutrient supply changes over time. As well, year to year differences can provide the fertilizer industry signals of anticipated demand. The relevance to an individual field is quite limited. The data presented here is a summary of fall 2011, and a three year comparison of N, P, K, and S soil supply rates as measured by PRS™ (Plant Root Simulator™) Probe Technology at Western Ag Labs Ltd.

Introduction

The PRS Probe is a soil analysis technology utilizing ion exchange membranes that measure the bio-available supply rate of nutrients in the representative soil sample. The PRS Probes utilize both anion and cation exchange membranes encapsulated in either an orange or purple plastic probe. The probes are chemically pre-treated enabling the membranes to exhibit surface characteristics and nutrient sorption phenomena that resemble a plant root surface.

The PRS Probes are a patented technology in seven different countries. The University of Saskatchewan holds the patent and Western Ag Innovations Ltd. holds the license to use the technology. The PRS Nutrient Forecaster™, used in conjunction with the PRS Probes, was released for commercial use in 1998 with lab analysis and consulting service delivered by Western Ag Labs Ltd. For brevity, the evolution of the PRS™ Technology can be reviewed in Greer et.al. (2003). An explanation of the laboratory analysis methodology and the Quality Assurance/Control procedures can be found in Hangs et.al. (2002).

Method

In research applications, the PRS Probes are often used *in situ* as shown in Fig. 1. In the analysis of agricultural fields for crop planning, composite soil samples are collected and sent to the lab where the PRS Probes are used under standardized conditions of soil moisture, temperature and time (Fig.2). The soil sampling protocol has a special focus. "Slices" of soil are collected in duplicate from 4 to 6 areas of the field. Sampling is approximately 10 cm deep while avoiding where the B horizon begins. The focus on shallow depth considers where the greatest concentration of organic matter exists, where the early crop nutrient uptake activity occurs, and avoids the more calcareous B & C horizons. Consideration is given to avoid "unusual" areas of the field that do not represent the "average" of soil conditions and characteristics. The data summarized in this paper was generated using this protocol.

In the crop planning consultation, the probe data must be run through the PRS Nutrient Forecaster™ (Fig. 3). The Forecaster is a computer model that integrates a number of dynamic factors influencing crop yield potential. Specific crop rooting characteristics, as constrained by soil physical and chemical properties, and soil nutrient supply rates are merged with of growing season moisture and heat to determine a crop's maximum yield. Synergies in crop nutrient use efficiency are integrated into the model's yield through the addition of balanced crop nutrition. The economics of "diminishing returns" is introduced using the farmer's own fertilizer costs and new crop price expectations. The focus is not on maximum yields, but on maximum economic yield. The power of the Forecaster comes through the ability to compare various growing season scenarios by crop and potential marketing opportunities. Crop nutrition plans are finalized that cater to the farmer's level of risk tolerance.

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

Figure 2. PRS™ Probes inserted into a composite field sample.

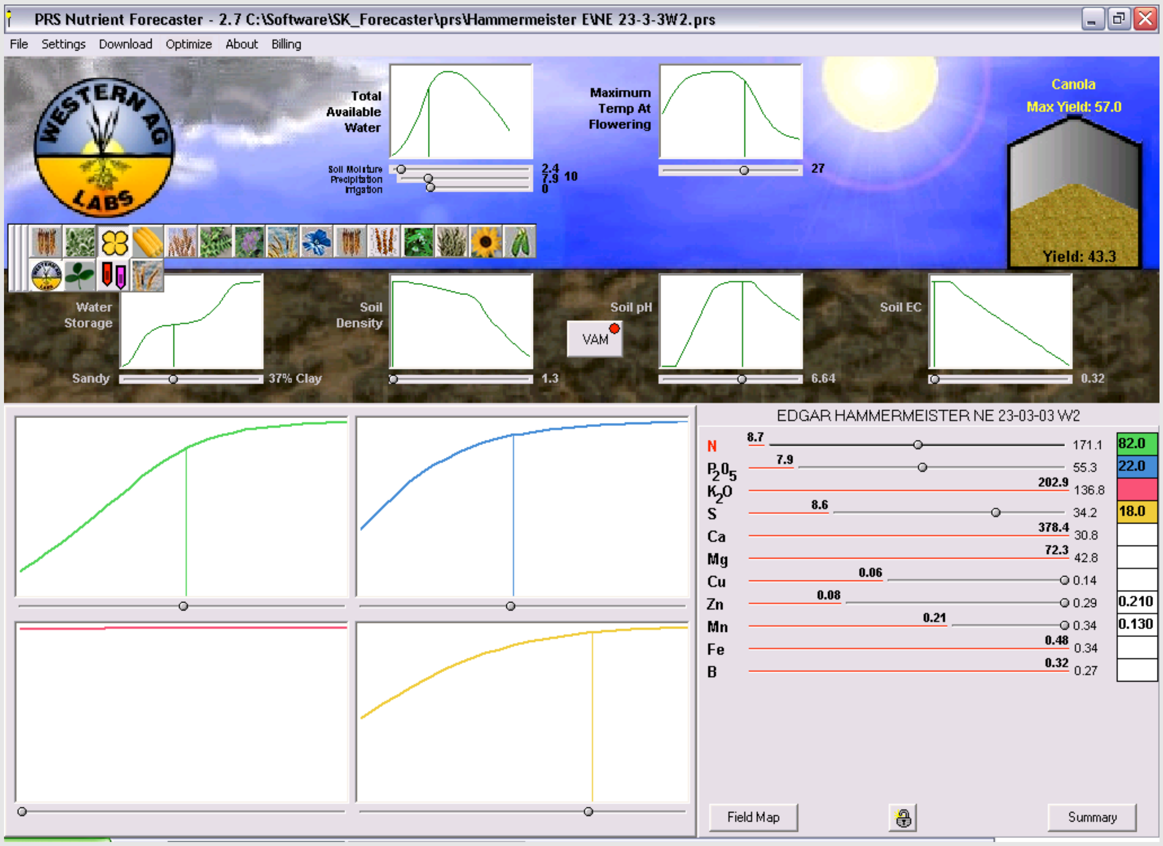

Figure 3. The PRS™ Nutrient Forecaster.

Results

Prior to discussing the 2011 fall results, it would be valuable to set some context to the data presented. The early growing season was marked by significant to extreme amounts of precipitation particularly in the southern third of the province (Fig. 4). The extreme precipitation in South central and South East Saskatchewan resulted in many fields going unseeded. The degree of timely weed control varied with the traffic ability of fields. Most field maintenance operations were made late to very late resulting in some nutrient uptake and immobilization.

The central and northern third of Saskatchewan's agricultural zone tended to have adequate precipitation though some dry pockets were present. Crop yields tended to be above average in these areas.

Through the fall, precipitation patterns had reversed into a strong drying trend (Fig. 5). This did facilitate the harvest of high quality grains and an active soil mineralizing nutrients were moisture allowed.

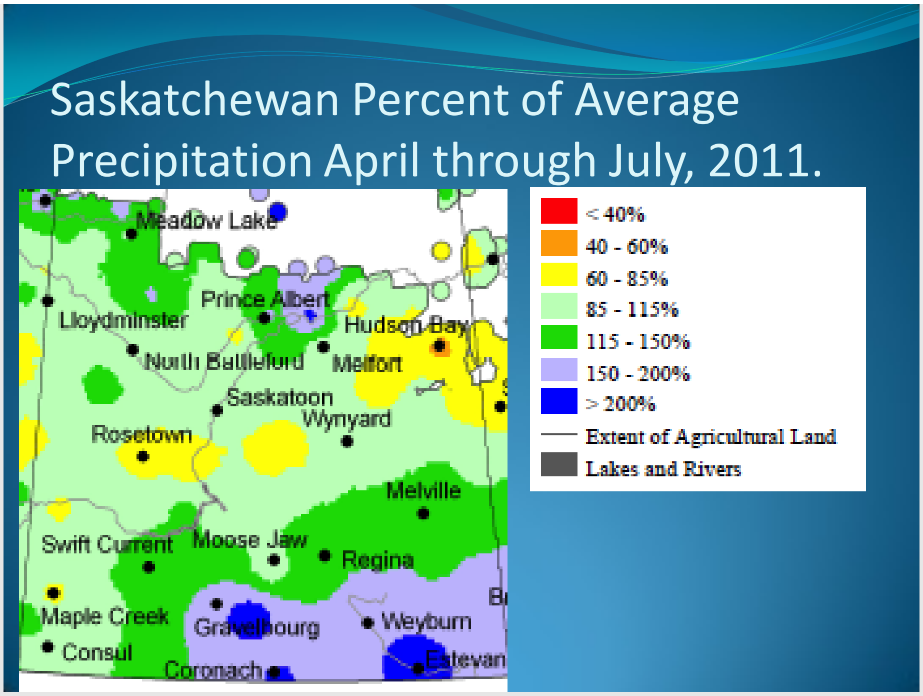

Figure 4 Saskatchewan percent of average precipitation, April through July, 2011.
Source:www4.agr.gc.ca/DW-GS/historical-historiques.jspx?lang=eng&jsEnabled=true

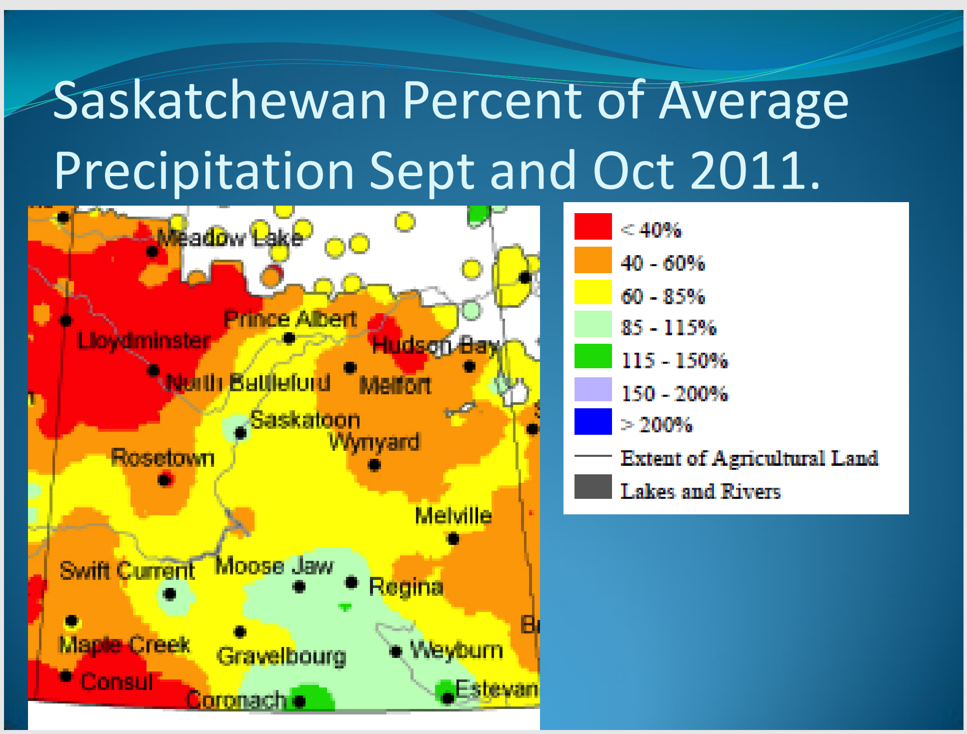

Figure 5 Saskatchewan percent of average precipitation, September and October, 2011.
Source:www4.agr.gc.ca/DW-GS/historical-historiques.jspx?lang=eng&jsEnabled=true

Shown in Figures 6-9 are a comparison of provincial nutrient supply rates from 2009 through 2011. The measured data is presented as a nutrient flux per unit surface area per time (i.e. μg/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. There can however be significant variance on fertilizer recommendations between crops.

Nitrogen (N) supply rates for the most part showed similar year to year tendencies in the mid-range of supply rates. There was however a significant increase in the fields showing high N levels. This would relate to the high mineralization rates found in the high number of fallow fields in Southern Saskatchewan seen in 2011(Fig. 6).

Phosphate (P) supply rates in fall 2011 tended to be lower than the previous years (Fig. 7). For the majority of the province, very good crops would have caused a greater draw down in P supply. Farmers will need to monitor this closely so as to not create too large a deficit in P fertility.

The soil supply rate of Potassium (K) (Fig. 8) also shows a similarity between years in the mid-range of supply rates. There was a tendency to find a slightly higher percentage of fields deficient in K supply, approximately 40% in 2011 vs approximately 29% in 2010. In the Western Ag Lab customer consultations, there was extra interpretation required prior to making a K recommendation. The circumstances of a very dry fall to conduct soil sampling would have meant that little or no leaching of K from the crop residue would have occurred prior to sampling. This stored K would leach out to varying degrees depending on the winter and spring precipitation received. The degree of deficiency shown in the Forecaster model (crop specific) plus discussion on the probability of precipitation are considered in the final K recommendation.

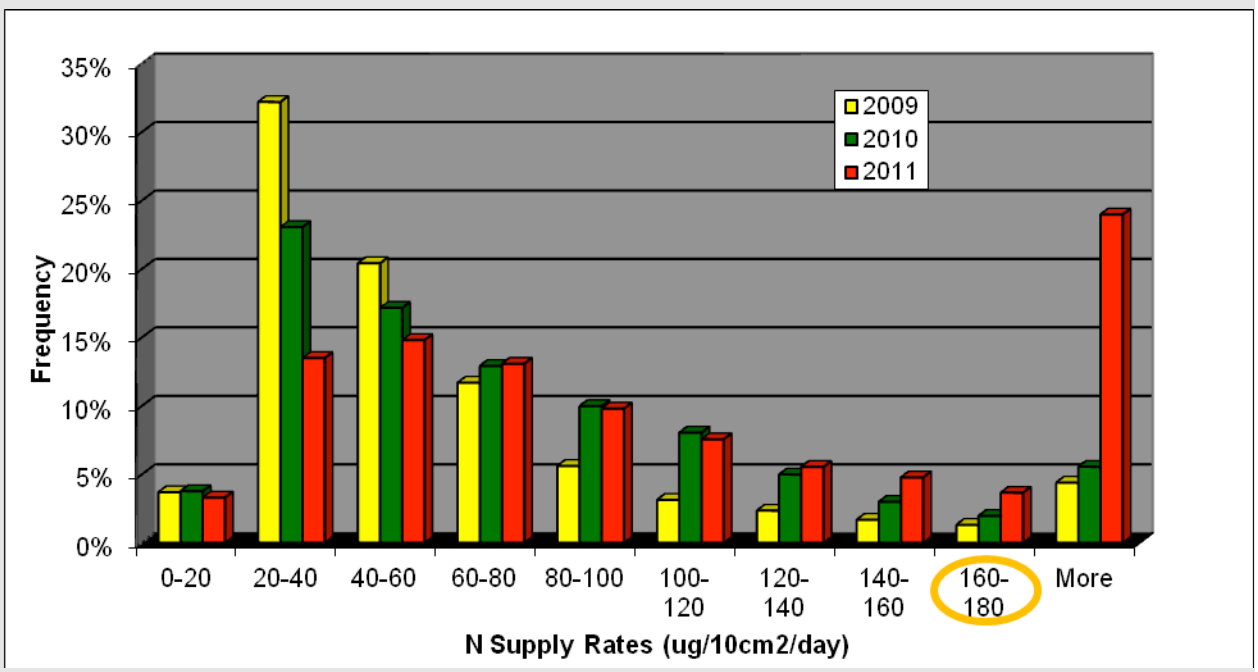

Figure 6. N Supply Rates Comparing 2009-2011.

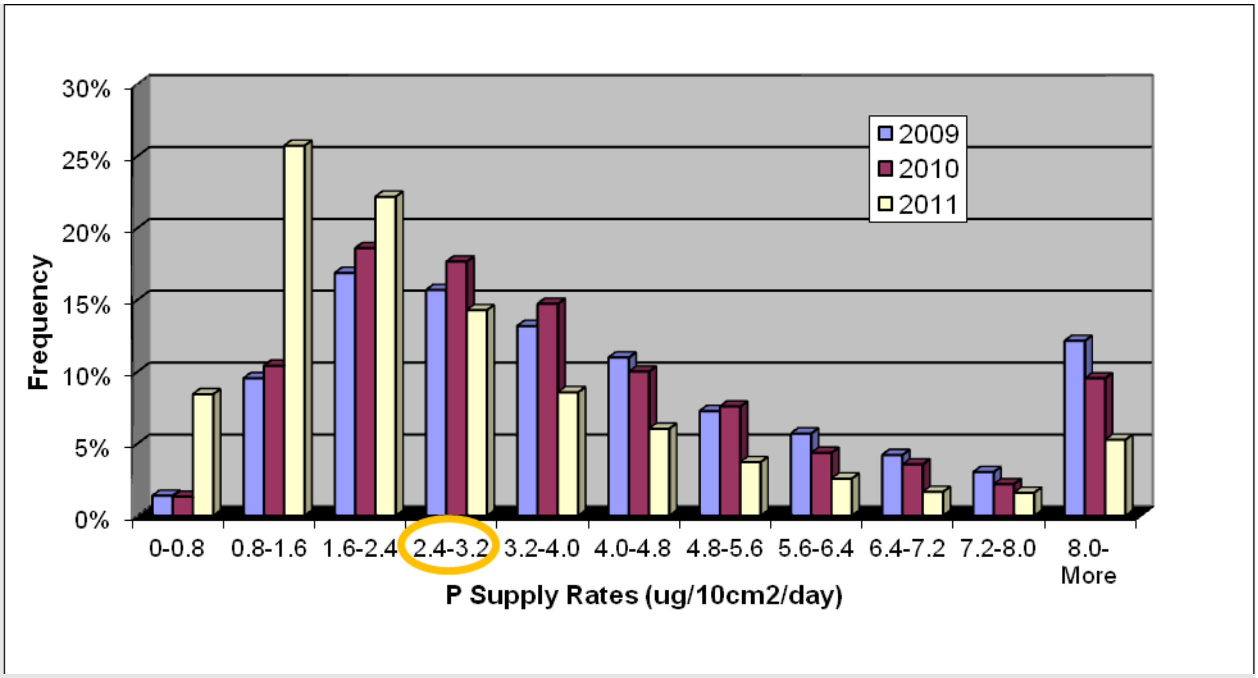

Figure 7. P Supply Rates Comparing 2009-2011.

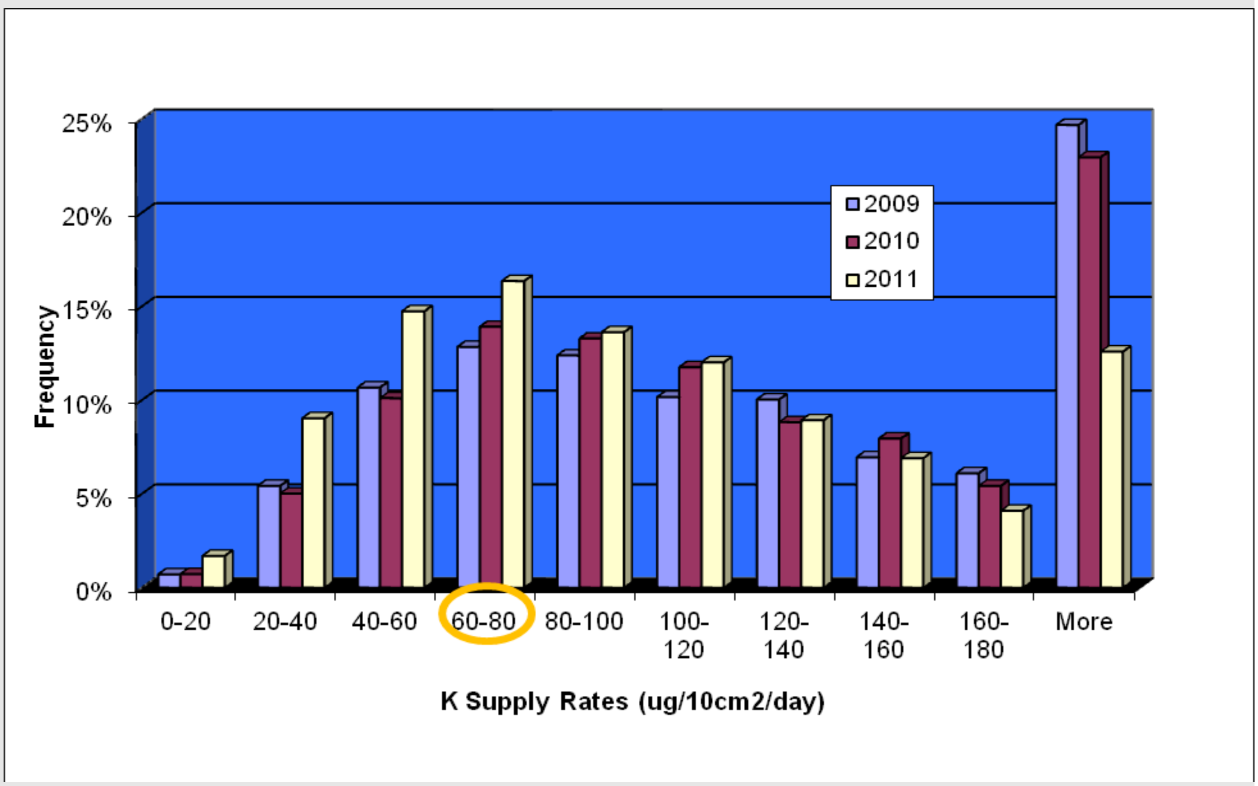

Figure 8. K Supply Rates Comparing 2009-2011.

Sulfur supply rates (Fig. 9) showed a slight improvement relative to 2010. Sulfate S levels are extremely variable across a field due to changes in parent material, organic matter and salinity and it is not unusual to sample "hot spots" from time to time. Extra consideration is given to S fertilization when these circumstances arise. With the warm dry conditions through fall, there was a tendency for more Sulfate S to move toward the surface relative to 2010. It was also noted in reports from the field that a "bath tub" ring of sulfate had moved further out from depressions in relation to the amount of standing water on the landscape in the flooded areas in Southern Saskatchewan.

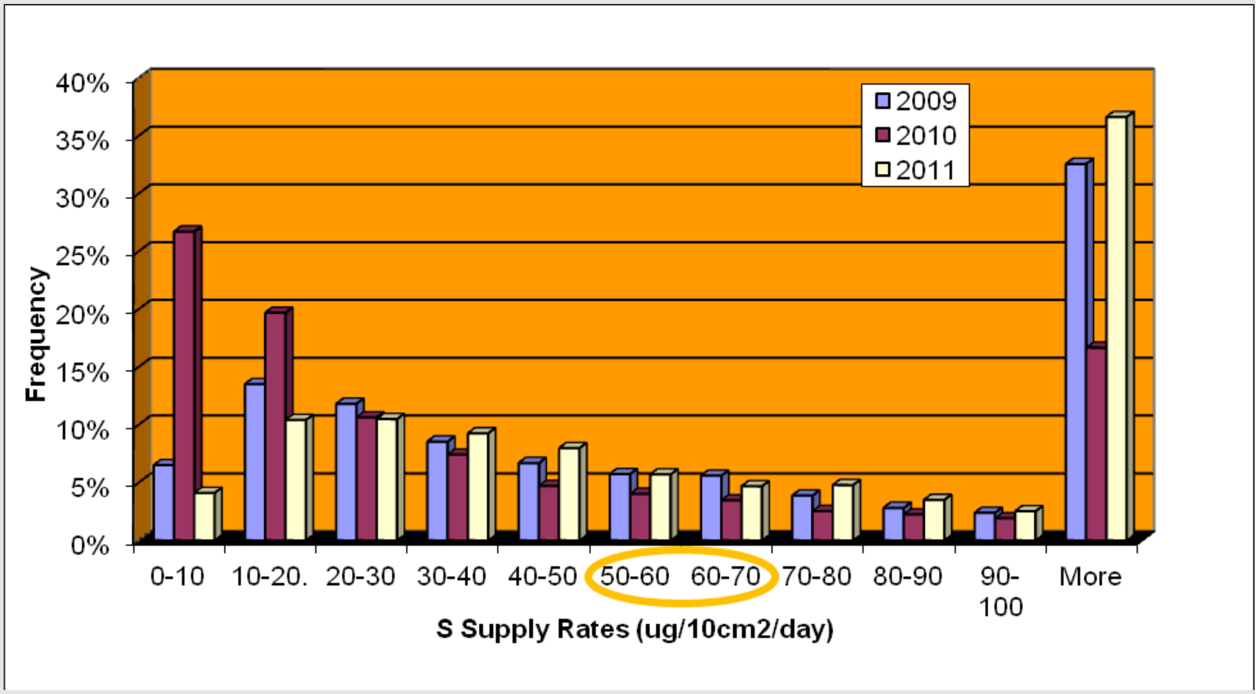

Figure 9. S Supply Rates comparing 2009-2011.

Conclusions

Though the data presented is not useful to develop individual field crop nutrition plans, monitoring yearly data 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.

Since 1998, PRS™ Technology has proven, through farmer experience, to be a useful decision support tool that optimizes economic crop yield while catering to the individual farmer's risk tolerance.

References

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