2009 – THE SUMMER OF PLANT ANALYSIS: WHAT DID WE LEARN?

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Introduction

There was a significant increase in the number of samples submitted for plant analysis to the UW Soil and Plant Analysis Laboratory during the 2009 growing season. The objective of this study was to analyze the data from plant samples submitted to the UW Soil and Plant Analysis Laboratory over the past five years to determine if any relevant plant nutrition trends appear.

Methods and Materials

Data from plant sample submissions to the UW Soil and Plant Analysis Laboratory from June 1 through August 31 in each year from 2005 to 2009 were compiled into a database. The data included the date submitted, county, crop, crop growth stage, appearance (normal or abnormal), N, P, K, Ca, Mg, S, Zn, Mn, B, Fe, Cu, Al, and Na nutrient concentrations and sufficiency range interpretations for all of nutrients except Al and Na. Additional data included soil test results if soil was submitted along with the plant sample. Basic descriptive statistics were used to analyze this data set.

Results and Discussion

The number of plant samples submitted to the lab has increased dramatically over the past few years from a low of 292 samples in 2007 to a high of 1255 samples in 2009 (Table 1). One factor in the increase in sample submissions, is that one client expanded services in the area of crop diagnostics using plant analysis. While the number of samples has increased, the percentage of samples submitted as being abnormal in appearance, as opposed to normal, has remained relatively steady at 20.7, 22.2, 30.5, 15.1, and 16.3% of total samples in 2005 through 2008, respectively. As the number of plant samples has increased the percentage of soil samples submitted along with plant samples has decreased. In 2005 through 2009, 66.3, 75.0, 57.9, 43.2, and 19.5% of plant samples, respectively, were submitted with soil samples. These data suggest that most samples are submitted from normal appearing fields and are not necessarily submitted as a pairing of samples from abnormal and normal parts of the field to assist in problem diagnosis.

The data was further analyzed for the three major crops in Wisconsin: alfalfa, corn, and soybean. For the 2008 and 2009 data, the proportion of samples in each sufficiency range category (low, sufficient, or high) for each crop and appearance (abnormal or normal) was determined for the key macro and micronutrients that are typically of importance in Wisconsin (N, P, K, S, Zn, Mn, and B). For alfalfa, 85 and 44% in 2009 and 67 and 29% in 2008 of the abnormal and normal samples, respectively, were low and possibly deficient in S (Table 2). These data are not surprising considering that atmospheric deposition of S has decreased significantly over time (NADP, 2009) and Northeast Iowa has observed increases in S deficiency recently (Lang et al., 2006). Next to S, K is the second most deficient nutrient for alfalfa (40% and 41% in 2009 and

17 and 14% in 2008 for abnormal and normal samples, respectively). Again a trend that is not surprising considering the reports from agronomists and ag retailers of reduced or nonexistent applications of potash to alfalfa over the last few years.

For corn, N was low is more samples than any other nutrient in both years (Table 3). Zinc was deficient in both abnormal and normal samples (32 and 24%, respectively) in 2008, while K was the second most likely nutrient to be deficient in 2009. It is important to note that the data for corn is summarized over all growth stages submitted: 12 inches tall, pre-tassel, and tassel to silk. However, the sufficiency range interpretations are based on the growth stage that was selected by the client at the time of sample submission.

Nearly all soybean samples submitted were interpreted as being low in S. In addition 36 to 50% of the samples were low in Mn, and N and K were often low as well. In 2009, the data suggest that soybeans submitted as normal in appearance were just as likely to be deficient in N, S, and Mn as those submitted as abnormal. In the Wisconsin plant analysis interpretation system, there is only one interpretation option for soybeans and it is for samples collected prior to/at first flower. This growth stage typically occurs from late-June until early-July. In each year many, if not a majority of the soybean samples were submitted in late-July through the end of August. Therefore, the sufficiency range interpretations were likely inappropriate for many of the samples submitted. As crops develop the critical nutrient range decreases (Havlin et al., 2005). If the crop was at pod fill when sampled and the interpretation range is for first flower, it could be expected that the many of the nutrients would be incorrectly interpreted as deficient.

Conclusions

In-season plant analysis to assess a crop's nutrient status is becoming more popular based on the increase in number of samples submitted over the last few years. Alfalfa data suggests that S and perhaps K may be limiting crop yields on many fields, if samples submitted to the lab are representative of the entire state. Additional analysis of this data using the DRIS (Diagnostic Range Interpretation System) may provide additional insights for all major crops. The data also suggest that extension programming efforts are needed to explain the use and limitations of plant analysis such that samples are taken at appropriate times to assist in interpretation.

References

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Table 1. Number of plant samples submitted to the lab in various crop categories along with the number of soil samples submitted from June 1 through August 31 in each year from 2005 through 2009.

	Year				
Crop or Soil	2005	2006	2007	2008	2009
	Number of observations, n				
Alfalfa	23 (5, 18)†	59 (4, 55)	21 (10, 11)	13 (6,7)	47 (20, 27)
Corn	69 (32, 37)	114 (39, 75)	86 (24, 62)	111(37,74)	567 (119, 448)
Soybean	19 (15, 4)	28 (13, 15)	34 (19, 15)	135 (24, 111)	230 (39, 191)
All vegetables	25 (16, 9)	2 (1, 1)	14 (5, 9)	33 (7, 26)	30 (13, 17)
Cranberry	84 (0, 84)	53 (0, 53)	54 (18, 36)	93 (2, 91)	236 (3, 233)
Grape	15 (0,15)	17 (2, 15)	19 (2, 17)	49 (1, 48)	40 (2, 38)
Fruit, other	161 (6, 155)	39 (3, 36)	57 (8, 49)	132 (4, 128)	40 (3, 37)
Other‡	19	12	7	55	65
Total Crop	415	324	292	621	1255
Total Soil	275	243	169	287	245

† Total number of samples followed by the number of samples identified as being abnormal and normal in appearance, respectively, in parenthesis where appropriate.
‡Other includes wheat and other small grains, forage legumes other than alfalfa, tobacco, trees, grasses, and unreported crops.

Table 2. Proportion of alfalfa samples (growth stage: bud to 1st flower or hay at harvest) submitted that were in each nutrient sufficiency range interpretation category for samples submitted as normal or abnormal in 2008 and 2009.

Year/ Crop appearance	Interpretation category	N	P	K	S	Zn	Mn	B
2009								
Abnormal	High	0.10	0.25	0	0	0	0	0
	Sufficient	0.70	0.70	0.60	0.15	0.95	0.9	0.85
	Low	0.20	0.05	0.40	0.85	0.05	0.1	0.15
Normal	High	0.30	0.22	0.22	0	0	0	0
	Sufficient	0.60	0.71	0.37	0.56	0.85	0.93	0.85
	Low	0.11	0.07	0.41	0.44	0.15	0.07	0.15
2008								
Abnormal	High	0	0	0.17	0	0	0	0.17
	Sufficient	0.83	1.0	0.66	0.33	0.67	1.0	0.83
	Low	0.17	0	0.17	0.67	0.33	0	0
Normal	High	0.57	0.29	0.14	0	0	0	0
	Sufficient	0.29	0.71	0.72	0.71	0.71	1.0	0.86
	Low	0.14	0	0.14	0.29	0.29	0	0.14

Table 3. Proportion of corn samples (all growth stages: 12 inches tall, pre-tassel, and tassel to silk) submitted that were in each nutrient sufficiency range interpretation category for samples submitted as normal or abnormal in 2008 and 2009.

Year/ Crop appearance	Interpretation category	N	P	K	S	Zn	Mn	B
2009								
Abnormal	High	0.14	0.17	0.31	0	0.08	0.10	0.03
	Sufficient	0.39	0.66	0.42	0.84	0.83	0.86	0.94
	Low	0.47	0.17	0.27	0.16	0.09	0.04	0.03
Normal	High	0.16	0.21	0.29	0.01	0.10	0.03	0.07
	Sufficient	0.5	0.73	0.55	0.93	0.86	0.94	0.89
	Low	0.34	0.06	0.16	0.06	0.04	0.03	0.04
2008								
Abnormal	High	0.08	0.11	0.35	0.05	0.03	0.08	0.03
	Sufficient	0.11	0.73	0.60	0.90	0.65	0.92	0.97
	Low	0.81	0.16	0.05	0.05	0.32	0	0
Normal	High	0.16	0.15	0.37	0.10	0.14	0.07	0.32
	Sufficient	0.29	0.74	0.45	0.76	0.62	0.89	0.68
	Low	0.55	0.11	0.18	0.14	0.24	0.04	0

Table 4. Proportion of soybean samples submitted that were in each nutrient sufficiency range interpretation category (based on growth stage: prior to/at initial flowering)† for samples submitted as normal or abnormal in 2008 and 2009.

Year/ Crop appearance	Interpretation category	N	P	K	S	Zn	Mn	B
2009								
Abnormal	High	0.03	0	0.18	0	0.03	0	0
	Sufficient	0.20	1.0	0.36	0	0.96	0.54	0.87
	Low	0.77	0	0.46	1.0	0.03	0.46	0.13
Normal	High	0.03	0.01	0.17	0	0.01	0	0
	Sufficient	0.27	0.96	0.68	0	0.96	0.64	0.86
	Low	0.70	0.03	0.15	1.0	0.03	0.36	0.14
2008								
Abnormal	High	0.08	0.08	0.38	0	0	0	0
	Sufficient	0.67	0.75	0.45	0	0.96	0.50	0.46
	Low	0.25	0.17	0.17	1.0	0.04	0.50	0.54
Normal	High	0.01	0.05	0.34	0	0.01	0	0
	Sufficient	0.81	0.92	0.60	0.01	0.93	0.42	0.53
	Low	0.18	0.03	0.06	0.99	0.06	0.58	0.47

†In both years samples were submitted from early- to mid-June and through late-August and were listed as being in the prior to/at initial flowering growth stage. It is likely that a majority of the samples submitted were older than initial flowering growth stage. Thus, the sufficiency range interpretation ranges are likely inappropriate for these samples.

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