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Northern Utah Alfalfa Nutrient Survey 2008

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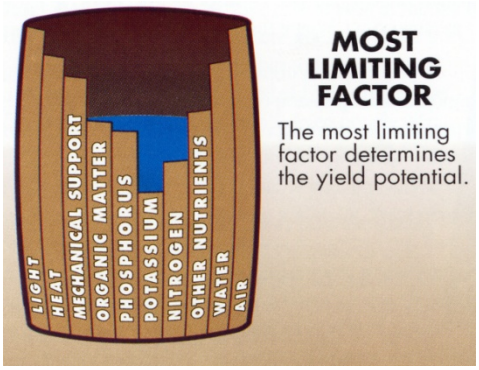
Determining the nutrient needs of a crop is essential to maintaining production at economic levels. Soil testing has been the predominant method for evaluating these needs. There are 17 nutrients which are essential for plant growth. Of those, oxygen, hydrogen and carbon are supplied by water and the air. The other 14 are provided by the soil. If crop production is to reach its full potential, these nutrients need to be balanced appropriately. The Most Limiting Factor principle states that, "**the level of crop production can be no greater than that allowed by the most limiting of the essential plant growth factors**". [1] Thus, if potassium is the most limiting factor, fertilizing with additional phosphorus will result in a much smaller yield increase than if the potassium need were provided with it.

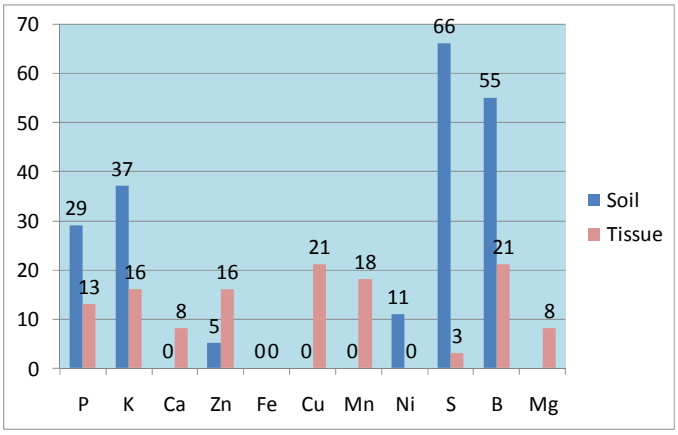
17 Essential Nutrients for Plant Growth			
Water and Air supplied	Primary Nutrients	Secondary Nutrients	Micro-nutrients
H *Hydrogen*	N *Nitrogen*	S *Sulfur*	Z *Zinc*
O *Oxygen*	P *Phosphorus*	Ca *Calcium*	Cu *Copper*
C *Carbon*	K *Potassium*	Mg *Magnesium*	Fe *Iron*
			Mn *Manganese*
			Mo *Molybdenum*
			B *Boron*
			Ni *Nickel*
			Cl *Chlorine*

Few Utah producers have tested for the secondary and micronutrient levels in their fields. A survey of 38 alfalfa fields in 10 northern Utah counties was conducted in the summer of 2008 to determine if deficiencies are occurring in the secondary and micro-nutrients. If a significant number of deficiencies were identified, producers would be encouraged to add them into their routine analyses.



In season secondary and micro-nutrient needs are best evaluated with a tissue analysis. In the survey, both a soil test and tissue test were conducted on each of the fields. In most cases the samples were collected just before the first cutting of alfalfa was harvested. The number of fields evaluated in each county was determined by the number of irrigated crop acres in that county.

Figure 1. Percent of Fields Deficient.

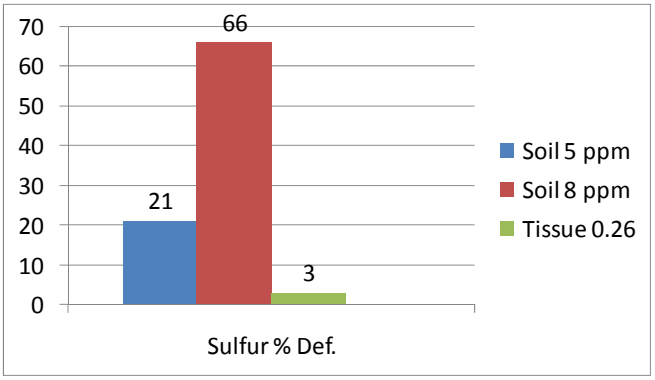


(Adequacy levels for the Ni soil test and the Mg tissue test were not available)

The large variation between the results of the soil test and the tissue test is shown in Figure 1. Since the tissue test is generally more accurate than the soil test, producers are encouraged to use a tissue test when an evaluation for secondary and micro-nutrients is desired.

Adequacy levels for the nutrients will vary with the tests used to evaluate them. Some tests have a broad range of values which are considered marginal rather than clearly deficient or adequate. For example the soil test for sulfur is not very accurate, so soil values between 5 and 8 parts per million (ppm) are considered marginal. Depending on the source, the tissue analysis adequacy level for sulfur ranges from 0.19 to 0.26 % S. The variation in the percent of fields that could be considered deficient is illustrated in Figure 2.

Figure 2. Adequacy Levels Affect on % Fields Deficient.



The alfalfa tissue test adequacy levels presently being used by Utah State University are in Table 1.

Table 1.

USU Alfalfa Tissue Adequacy Levels					
N %	P %	K %	Ca %	Mg %	S %
4.5	0.26	2.0	1.3	0.25	0.26
Zn ppm	Fe ppm	Mn ppm	Cu ppm	B ppm	Mo ppm
21	30	25	5	30	1.0

USU values are primarily derived from "Plant Analysis Handbook" by James, Wolf & Mills, 1991.

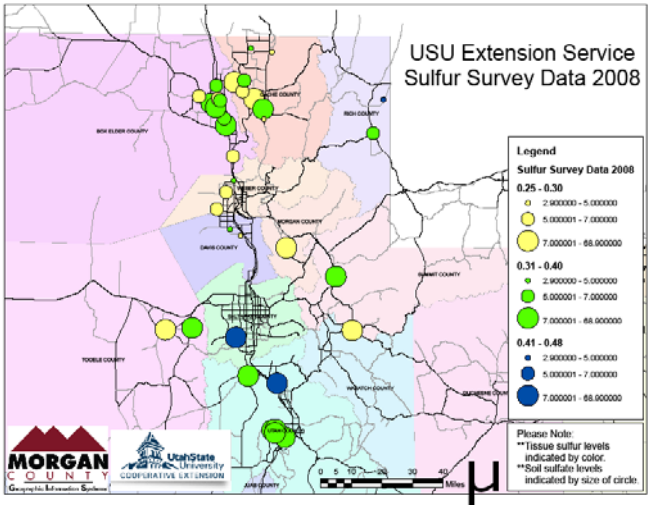
The question of how well the soil and tissue tests correlate with each other is important in determining which test to use. Tissue tests are generally considered to be more reliable than soil tests. A statistical evaluation of the P, K, S, and B results showed that the soil and tissue tests for K were well correlated, the tests for B were moderately correlated and the tests for P and S were not correlated. The statistical '*P value*' shown in Table 2 needs to be less than .05 for the correlation to be considered strong.

Table 2.

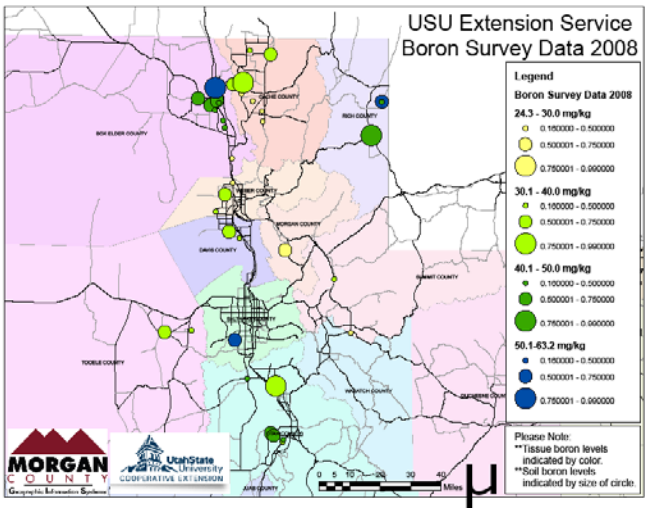
'*P Values*' for Soil vs. Tissue Test Correlation			
Phosphorus P	Potassium K	Sulfur S	Boron B
0.4019	0.0001	.3505	0.018

Maps 1 (sulfur) and 2 (boron) substantiate the statistical determination that the soil and tissue tests for sulfur are not correlated, but they are for boron. Each sampling site is represented by a colored circle. Yellow circles indicate a deficient reading from the tissue test, while small circles indicate a deficient reading from the soil test. If the two tests are correlated most of the yellow circles will be small. The yellow circles are not predominantly small on the sulfur map, but they are on the boron map, thus the two tests are not correlated for sulfur, but are correlated for boron.

Map 1 Sulfur



Map 2 Boron



Survey Conclusions

- P, K, Zn, Cu, Mn, S, & B deficiencies probably occur in 10 percent or more of Northern Utah alfalfa fields.
- Ca, Mg & possibly Ni deficiencies occurred in a few fields.
- Tissue analyses need to be used if secondary and micronutrient levels are to be evaluated.
- More research needs to be completed to establish reliable adequacy levels for alfalfa tissue at pre-bloom maturities.
- Paired tissue samples of healthy and suspected deficient fields would assist in identifying nutrient problems.

Things to Consider when Using a Tissue Analysis

- Nutrient concentrations change as the plant matures. Concentrations are generally higher in younger tissue.
- Growing conditions can effect nutrient concentrations. Plants growing in drought or stressed conditions may have a lower tissue analysis concentration than those plants growing under ideal conditions
- The forms and fee required for a tissue analysis at the Utah State University Analytical Laboratory (USU-AL) are available at http://www.ususal.usu.edu. The analysis will provide tissue levels for N, P, K, Ca, Mg, Na, S, Fe, Zn, Mn, & Cu.
- In the future it may be possible to have core samples taken from dry baled hay serve as the tissue sample analyzed for crop nutrient needs.

Procedures for Taking an Alfalfa Tissue Sample for Analysis

- Take the sample as close to cutting time as possible. Second cutting is recommended because first cut growth has access to nutrients which have mineralized over the winter and may not provide a true representation of the nutrient level of the soil during the majority of the growing season.
- Collect the top 6 to 8 inches of stem from 50 plants distributed throughout the field or area to be tested. If the sample is dusty; gently rinse with water and pat dry with a paper towel.
- Put the tissue sample in a paper bag and label it with the field I.D., your name and the date.
- Complete the "Plant Analysis" submission form. The submission form can be obtained from the Internet at http://www.usual.usu.edu/forms/plantform.pdf or from your local Extension office.
- Put the tissue samples, submission form and payment into a large envelope and next day mail them to the USU-AL or air dry the sample and get it to the USU-AL when you can. Air dried samples will not provide accurate nitrogen content results.

[1] "The Nature and Properties of Soils," 8th edition, 1974, Nyle C. Bradley, Ch. 2.

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