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Misleading Deficiencies in Cotton

Statistics can be misleading. Recently, I came across the attached figure from a private agricultural laboratory that runs lots of cotton leaf samples from Alabama. The publication summarizes plant tissue samples run by the laboratory for cotton since 1989. It implies that nitrogen (N), potassium (K), calcium (Ca), and zinc (Zn) deficiencies are widespread in our region. I'm sure some fertilizer vendors will use these data to justify selling their growers more of these nutrients. This can be costly and unjustified because research just doesn't back up the impression presented by this figure. We have no idea what criteria were used for determining "deficiency" except that the samples were taken at "early bloom". Were they petiole samples, leaf blade samples, or whole plant samples? What critical values were used for each element? Where are the reference values? Were these samples from healthy crops or from problem fields? Diagnosing problems from a plant sample is not easy; there are just too many unknowns to put much faith in these published numbers.

Nitrogen in the cotton plant is affected by any number of growth factors that can affect the concentration in leaves and petioles. Young leaves are generally higher in total N than older leaves. A rapidly growing crop may have a lower leaf N concentration than a stressed crop. Petioles are usually tested for nitrate-N and not total N and the interpretation can be tricky unless you are monitoring the crop over several weeks.

We know we need **potassium** fertilizers for most cotton grown in the Coastal Plain region of the South and even our cotton leaf data from the Auburn University laboratory suggests widespread low leaf potassium levels. In spite of extensive and on-going research, we rarely see responses to applied K if the soil test recommendations are followed. This suggests that we need to adjust what we are calling "deficient" in the leaves.

Calcium level in cotton leaves and petioles is affected by the age of the tissue and moisture conditions and is a very poor indication of calcium nutrition. Older leaves, diseased leaves, and drought-stressed leaves have higher calcium concentrations than healthy, young, fast-growing leaves. Some growers attempt to add more calcium to growing cotton but rarely has calcium fertilization resulted in increased yields. The values in the table are not deficient by any known reputable research. It's just what someone has chosen to identify as "deficient".

To my knowledge, there has never been a demonstrated yield or plant growth response to **zinc** fertilization by cotton in the Southeastern U.S. If this is so, then how can these values be "deficient." Again, they are just what someone has chosen to call "deficient".

% Cotton Deficiencies 1989 - 2001

Early Bloom Stage

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
N	10	12	16	15	21	36	27	22	18	19	23	21	27
P	3	17	5	6	8	9	20	15	12	14	16	18	15
K	51	53	75	63	55	56	74	62	56	58	64	62	67
Mg				24	21	14	17	15	13	13	15	19	22
Ca	17	11	61	41	35	46	57	62	68	62	66	63	67
S	1	1	1	0	1	9	8	5	6	7	6	9	11
B	1	2	3	1	1	6	6	3	4	4	5	7	4
Zn	19	15	28	30	41	39	44	35	32	29	34	31	36
Mn	3	2	3	2	2	8	7	5	6	6	8	7	6
Fe	1	3	1	0	1	1	6	1	1	1	1	1	1
Cu	5	0	2	1	1	4	6	2	3	2	2	3	2

This table was compiled by a private, agricultural laboratory and copied from a handout presented at a regional meeting. The name of the laboratory has been removed.

Interpreting a plant analysis by itself is difficult. A plant under stress from any factor (disease, drought, nematodes, too much water, not enough sunlight, cold damage, ozone damage, insect injury, low soil pH, etc.) could have several nutrients below an established sufficiency range. In fact, when reviewing a plant analysis report, if several nutrient elements appear to be below established sufficiency ranges, then you should suspect some problem other than plant nutrition. If all nutrients appear normal except for one, then it is possible that you have a true deficiency of that one nutrient. To make diagnosis easier, we often recommend plant leaf samples from both a "good" area in the field as well as the adjacent "bad" area. Soil samples may be needed along with the leaf samples and extensive knowledge of the crop, weather, variety, growing conditions, etc. are needed in order to diagnose a plant nutrient deficiency from a plant sample.

Research based plant analysis sufficiency ranges for most southern crops including cotton has been published by the Southern Soil Testing and Plant Analysis Extension and Research Activity (SERA-6).

http://www.agr.state.nc.us/agronomi/saaesd/scsb394.htm

These are the values used by those public laboratories that run plant analysis programs in the southern region (e.g., laboratories at Auburn University, University of Georgia, Clemson University, University of Florida, University of Tennessee, Mississippi State University, and University of Arkansas, among others).

Don't take one laboratory's chart as indication of widespread cotton nutrition problems. Growers should check with their county ag. agent, a specialist or a good cotton consultant before attempting to correct problems that may not exist. Have your own cotton fields tested by an unbiased agricultural laboratory who can correlate soil test results with plant tissue analysis to make a better recommendation for next year's cotton crop.

Sufficiency ranges for total nutrient concentration in cotton leaf blades based on research in the southern region of the United States (from Sou. Coop. Ser. Bul. No. 394)		
	Stage of Growth	
Nutrient	Early Bloom	Late Bloom/maturity
N (%)	3.0-4.5	3.0-4.5
P (%)	0.2-0.65	0.15-0.6
K (%)	1.5-3.0	0.75-2.5
Ca (%)	2.0-3.5	2.0-4.0
Mg (%)	0.3-0.9	0.3-0.9
S (%)	0.25-0.8	0.3-0.9
Cu (ppm)	5-25	(not available)
Zn (ppm)	20-200	50-300
Fe (ppm)	50-250	50-300
Mn (ppm)	25-350	10-400
B (ppm)	20-80	15-200

Charles Mitchell
Extension Agronomist-Soils & Professor