PLANT TISSUE ANALYSIS: DO THE NUMBERS MAKE SENSE?

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ABSTRACT

Corn plant tissue analysis results from 2016 to 2025, inclusive, were compiled for survey purposes. The survey results for two growth stage ranges (VE-V4 and R1) were compared to published sufficiency ranges. In several cases, these sufficiency ranges may have overestimated the number of deficient plants, including nitrogen, phosphorus, magnesium, zinc, and sulfur. Refinement of the ranges for corn grown in the High Plains region is probably warranted.

INTRODUCTION

Plant analysis is a useful tool for diagnosing nutrient deficiencies and improving nutrient management. Crop advisers, retailers, and crop consultants often collect plant samples for lab analysis as a service to their corn producing clients. Analytical results are meaningless unless interpretations are available to help make management decisions.

Common interpretations include sufficiency ranges and survey values. Sufficiency ranges have been established by research to identify concentration ranges for essential nutrients within which optimum growth and/or yield can occur. These ranges are specific to certain plant parts and plant growth stages. Survey values are general concentrations or ranges based on acceptable visual appearance or acceptable yield.

Inquiries to several Extension specialists indicated that interpretations for corn plant tissue analysis were generally based on those published in Southern Cooperative Series Bull. #394, “Plant Analysis Handbook II”, or “Plant Analysis Handbook III”. The background references for the sufficiency levels often date from the 1970’s to the 1990’s. Corn yields have improved substantially since then, so the question arises whether the sufficiency levels accurately represent current conditions. The intent of this presentation is simply to compare commonly used sufficiency ranges to a survey of recent plant analysis results. It should be noted that the concentrations in the survey are not correlated to final yield.

MATERIALS AND METHODS

The results of corn plant tissue samples submitted to ServiTech Laboratories from 2016 to 2025, inclusive, were compiled for this survey. Results were grouped into six growth stage ranges: VE-V4, V6-V10, V12-V18, VT, R1, R2-R3. This represents early, mid-, and late vegetative or reproductive growth stages. The data set for each nutrient was initially trimmed by deleting the highest and lowest 0.25% of the population to eliminate extreme outliers. Table 1 lists the final size of the data populations. Data for each nutrient and growth stage range is shown graphically in Figures 1(a) through 1(n)

using box-and-whisker plots. The whisker ends represent the 1st and 99th percentiles. The box ends represent the 25th and 75th percentiles. The box center represents the 50th percentile (median). The larger boxes with dashed outlines represent the sufficiency ranges published in SCSB #394 for “Seedling (< 4 inches in height” and “Tasseling/Bloom”. This presentation style allows visual comparison of the sufficiency ranges to the survey population.

RESULTS AND DISCUSSION

The sufficiency ranges for the VE-V4 stage suggest that potentially 32% of the samples are N deficient, 35% are P deficient, and 3% are S deficient. Results suggest that potentially 7%, 3%, and 20% of samples for each of the cations, K, Ca, and Mg, are deficient. About 1% to 3% of Zn, Cu, and B results would be considered deficient.

The SCSB ranges note that the optimum N:S ratio should be between 10 and 15 at all growth stages, but sulfur is limiting at ratios greater than or equal to 18. The survey results show the N:S ratio for 43% of the VE-V4 samples were between 15 and 18. About 16% of samples had an N:S ratio greater than 18. This would suggest that 59% of the samples are potentially sulfur deficient according to the SCSB ranges.

The silking (R1) stage is generally considered to be the optimum time to evaluate fertility status with plant analysis. The sufficiency ranges at R1 suggest that potentially 42% of the samples represented in the survey data are N deficient, 26% are Mg deficient, and 27% are Zn deficient. About 11% and 2% of the K and Ca results, respectively, were below the sufficiency ranges. 2% and 4% of the Cu and B results, respectively, were below the sufficiency levels. About 60% of the N:S results at R1 are between 15 and 18 and 12% exceed N:S 18. This would suggest that according to the sufficiency range, a potential total of 72% of samples might be considered deficient.

CONCLUSIONS

Applying the SCSB #394 sufficiency ranges to the survey results suggested potential large-scale deficiencies for certain nutrients, notably N, S, Zn, and Mg. These ranges or very similar ranges are used for diagnostic and monitoring purposes by Extension, crop advisers, and consultants. The sufficiency levels are based on historical research in many cases. It may be prudent to review and revise them to reflect current corn genetics and production practices used in the High Plains region.

REFERENCES

Campbell, C.R. (ed.). 2000. Reference Sufficiency Ranges for Plant Analysis in the Southern Region of the United States (updated 2011). Southern Cooperative Series Bulletin (SCSB) #394. https://aesl.ces.uga.edu/sera6/PUB/scsb394.pdf (accessed 20Jan2026).

Mills, H.A. & J.B. Jones. 1991. Plant Analysis Handbook II (Revised 1996). MicroMacro Publishing, Athens GA.

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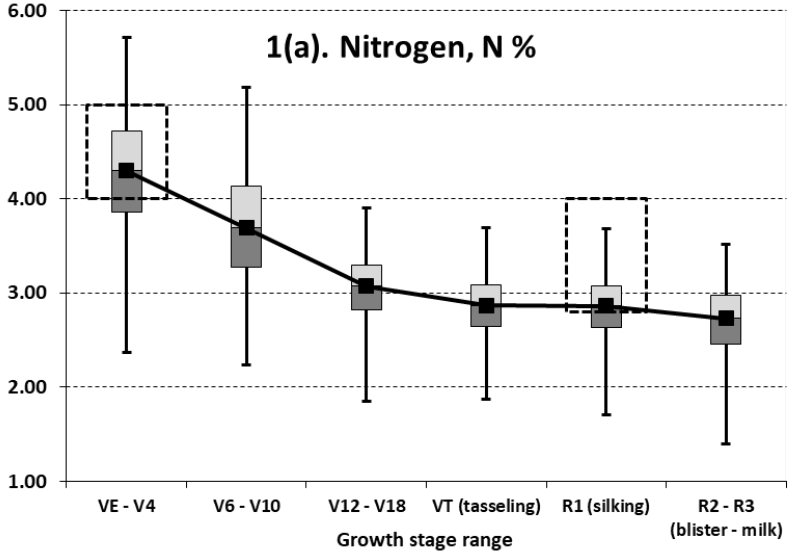
Hicks, C. NCDA&CS Plant Tissue Analysis Guide. North Carolina Dept of Ag. & Consumer Svc. Raleigh NC.

Table 1. Number of samples represented in survey.			
Growth stage range		NPK	Secondary & micronutrients
VE – V4	Emerg. to 4-leaf	4,870	3,674
V6 – V10	6-leaf to 10-leaf	13,372	13,069
V12 – V18	12-leaf to 18-leaf	4,412	4,086
VT	Tasseling	4,419	2,855
R1	Silking	4,978	4,525
R2 – R3	Blister - Milk	4,193	3,970

Table 2. Sufficiency ranges per SCSB #394					
	VE-V4	R1		VE-V4	R1
N %	4.00-5.00	2.80-4.00	Zn ppm	20-60	20-70
P %	0.40-0.60	0.25-0.50	Fe ppm	40-250	30-250
K %	3.00-4.00	1.80-3.00	Mn ppm	25-160	15-150
Ca %	0.30-0.80	0.25-0.80	Cu ppm	6-20	5-25
Mg %	0.20-0.60	0.15-0.60	B ppm	5-25	5-25
S %	0.18-0.50	0.15-0.60	N:S ratio	10-15	10-15

Figure 1. Distribution of corn plant tissue analysis results for (a) nitrogen and (b) phosphorus. Squares with dashed borders represent SCSB #394 sufficiency ranges.



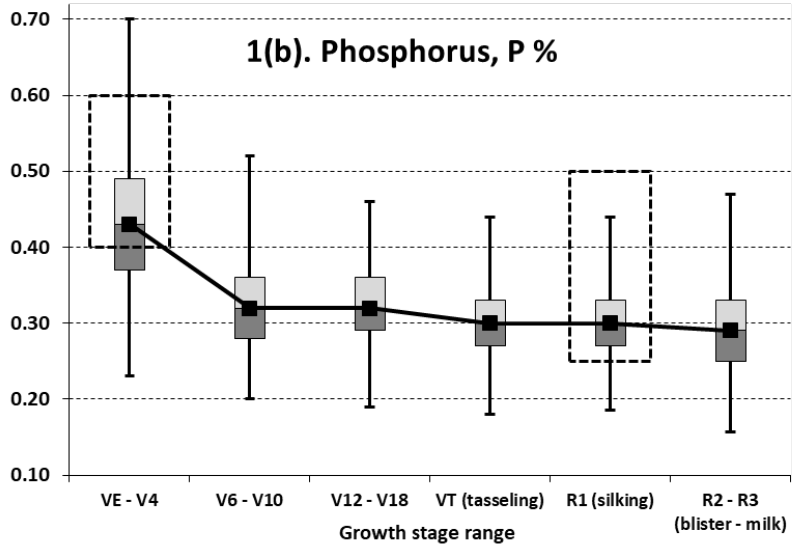
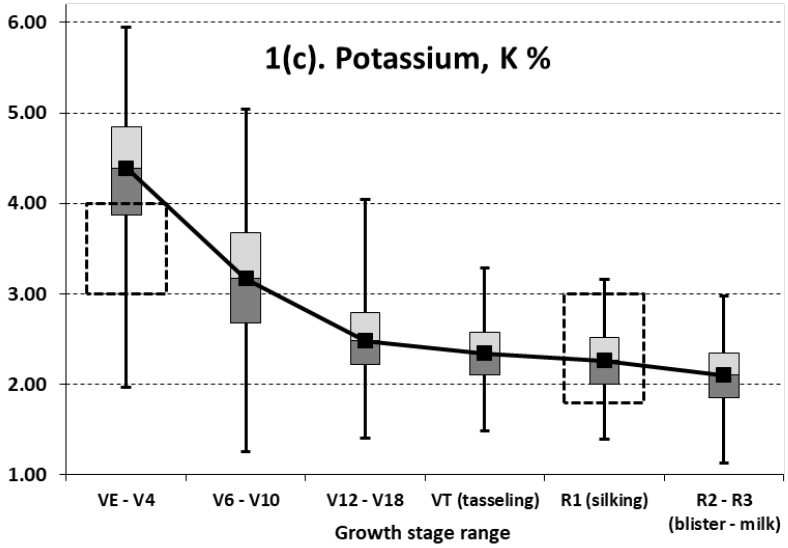
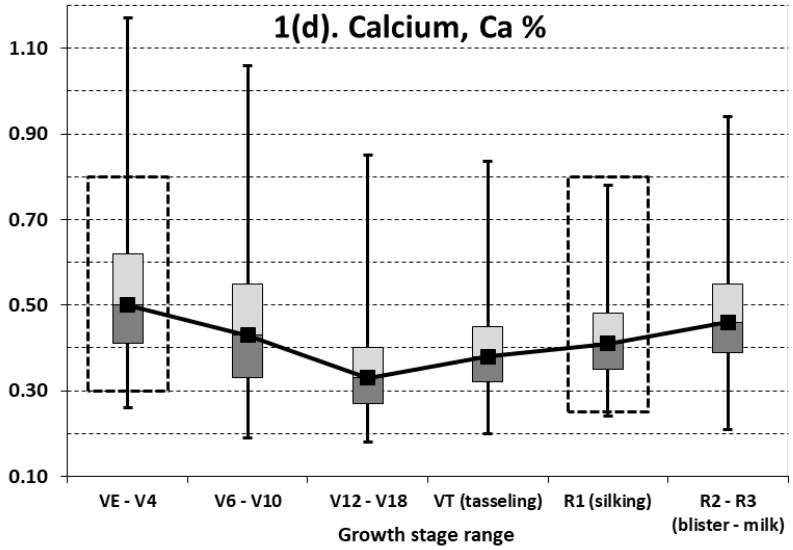
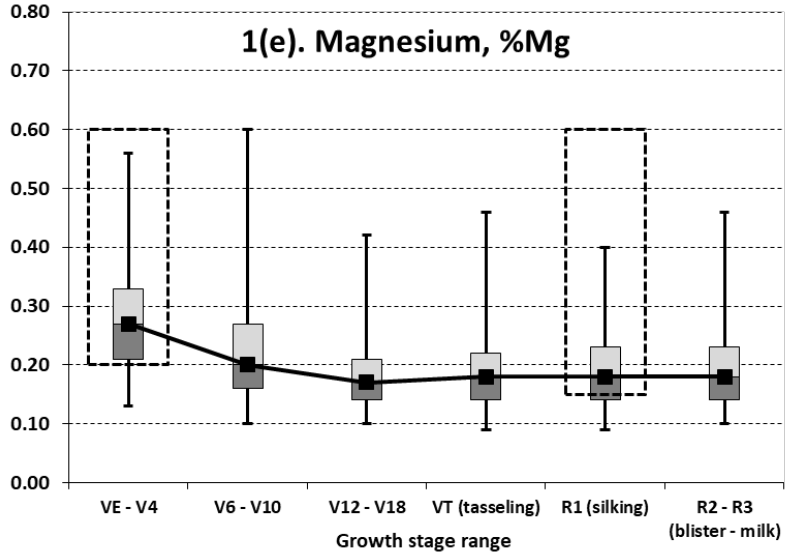


Figure 1. Distribution of corn plant tissue analysis results for (c) potassium, (d) calcium, (e) magnesium, and (f) sulfur. Squares with dashed borders represent SCSB #394 sufficiency ranges.







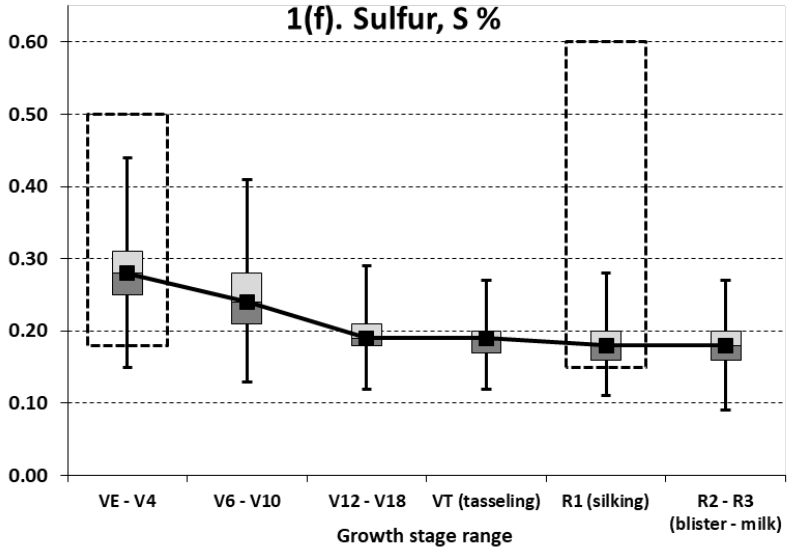
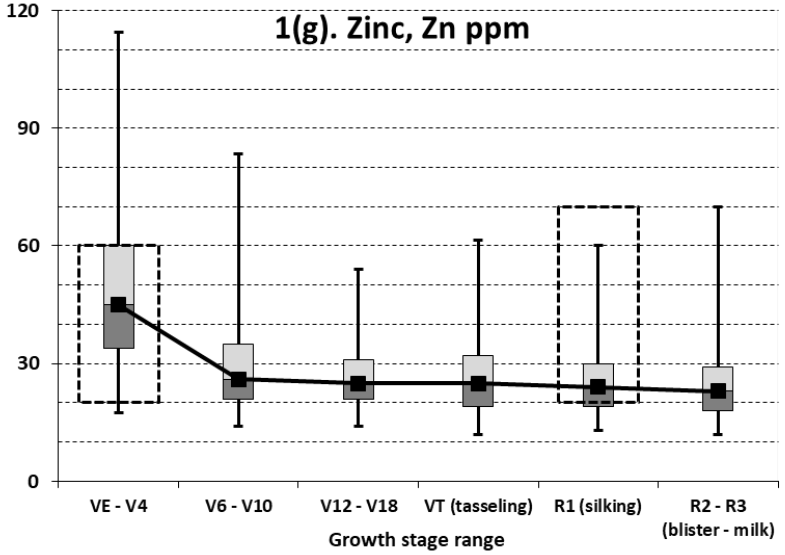
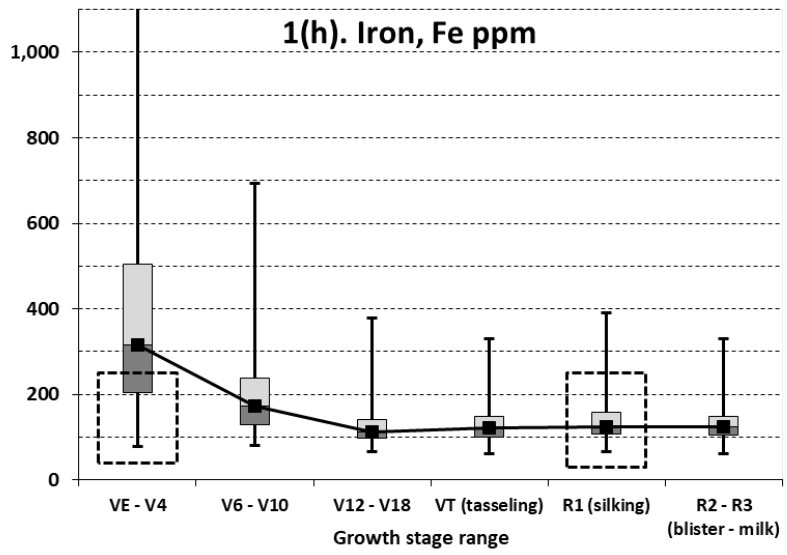
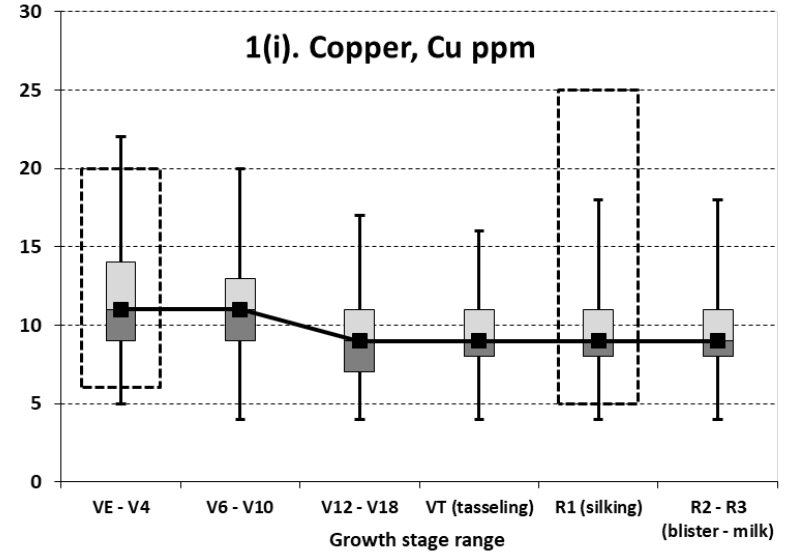


Figure 1. Distribution of corn plant tissue analysis results for (g) zinc, (h) iron, (i) copper, and (j) manganese. Squares with dashed borders represent SCSB #394 sufficiency ranges.







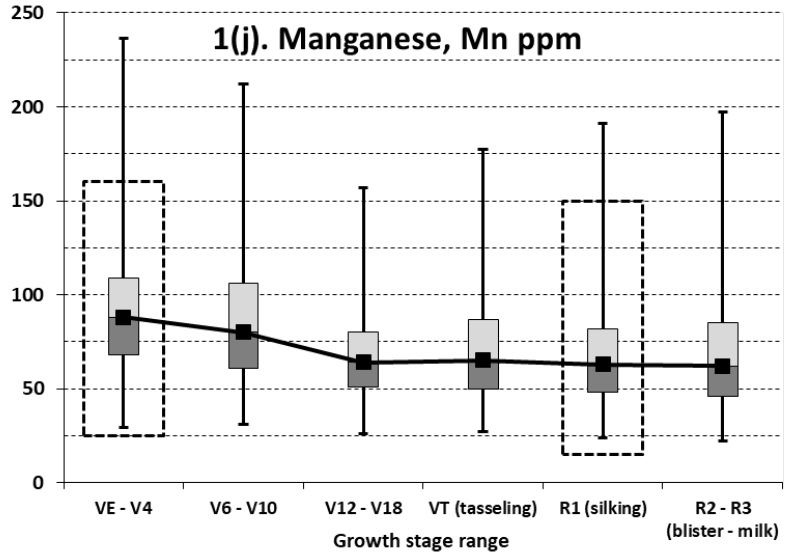


Figure 1. Distribution of corn plant tissue analysis results for (k) boron, (l) sodium, (m) nitrogen-to-sulfur ratio, and (n) nitrogen-to-potassium ratio. Squares with dashed borders represent SCSB #394 sufficiency ranges.