Temporal Variability in Tissue Nutrient Concentrations

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Introduction

The use of plant tissue analysis for mineral concentrations as an alternative method for fertilizer recommendation has steadily gained interest by farmers and crop advisers. Although this technique is an effective tool for confirming suspected deficiencies observed in the field, it has proven to be confusing in numerous crop monitoring programs. Plant tissue analysis vary with plant age, time of sampling, variety, & environmental conditions (Rehm 2015; Bates 1971).

Objective

To evaluate the stability of corn tissue nutrient concentrations across time of day, among days, and growth stages as affected by fertilizer application.

Materials and Methods

- 'Pioneer P0635AM' was planted on April 7, 2015 at Lake Carl Blackwell Agricultural Research Farm near Stillwater OK.
- A 5.3m x 7.6m area was divided into fertilized and unfertilized plots (Fig. 1). Fertilized plot received 193 kg ha^{-1} N, 158 kg ha^{-1} P_2O_5, 103 kg ha^{-1} K_2O, and 41 kg ha^{-1} SO_4 as pre-plant broadcast incorporated on May 26, 2015. Foliar application at 193 kg ha^{-1} was applied as urea on June 12, 2015.
- Normal and healthy corn leaves were collected by hand clipping the entire leaf at V4, V8 and R1/R2 growth stages in the morning (~8:00am), noon (~12:00nn) and evening (~5:00pm) for three consecutive days (day 1, day 2, day 3) (Table 1). At V4 and V8 stages, the youngest fully expanded leaf were collected as samples while the leaf underneath the ear was collected at R1/R2 stage.
- At each sampling time, 30 leaves were collected. A total of 270 leaf samples were collected in each growth stage.
- All leaf samples were submitted to the OSU Soil, Water, and Forage Analytical Laboratory for tissue analysis. Samples were analyzed for macronutrients (N, P, K, Ca, Mg, and S) and micronutrients (Mn, Cu, B, Fe, and Zn), however, only N, P, K, Ca, Fe, Zn and B are presented in this poster.
- All data were subjected to ANOVA and means were separated using Fisher's Protected LSD at α =0.05.

Figure 1. Plot lay-out at Lake Carl Blackwell, Stillwater OK

Results

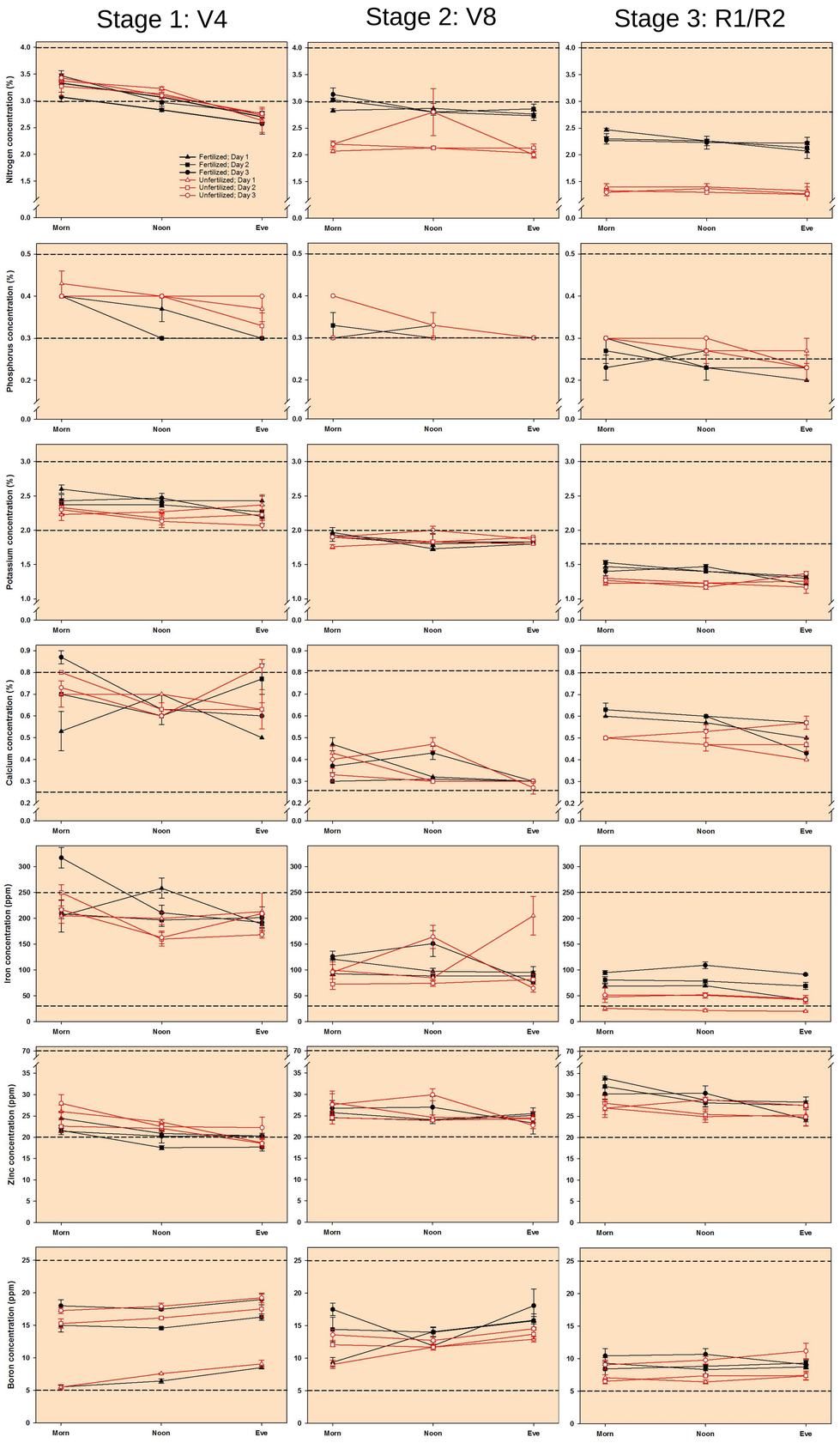

Figure 2. Tissue nutrient concentration in fertilized and unfertilized plots as influenced by sampling day and time of day sampling at different growth stages of corn. Morning (Morn), 8:00am; Noon, 12:00pm; Evening (Eve), 5:00pm. Broken lines are the upper and lower nutrient sufficiency level for corn (Plank and Tucker, 2000).

Table 1. Date of leaf sampling at different growth stages of corn.

Stage/Day	Day 1	Day 2	Day 3
V4	06-09-15	06-10-15	06-11-15
V8	06-23-15	06-24-15	06-25-15
R1/R2	07-14-15	07-15-15	07-16-15

Discussion

- Tissue concentrations of all nutrients varied across all stages (Figure 2).
- Stage 1: All nutrient concentrations were affected by time of day sampling except for K and S. Fluctuations of K, Ca, B and Zn concentrations were observed among sampling days. Fertilization affected N, B, and Cu concentrations.
- Stage 2: Day and time of day sampling impacted all nutrient concentrations except for N, S, Fe, and Zn. Fertilization impacted N, Mg, B, and Cu concentrations.
- Stage 3: Significant fertilization effects were observed in all nutrient concentrations. Mg and B concentrations were not affected by time of sampling. Day of sampling showed no effects on N, P, K and Zn concentrations.
- Environment (daily low/high temperatures and cloud cover i.e. light interception) significantly influenced nutrient concentration levels.

Conclusions

- Nutrient concentrations in plant tissues provided no distinct trend of what growth stage, day, or time of day is the best to conduct tissue sampling for corn.
- Growth stages, sampling day, and time of day significantly impacted plant nutrient concentration for all measured nutrients.
- Prior to this work OSU's stance on using tissue testing was that plant analysis alone cannot be used to make fertilizer recommendations. At this time OSU's stance on the use of tissue testing remains unchanged. While the use of plant analysis remains a useful tool in observing crop status, it should not be use to provide mid-season nutrient recommendations for corn in Oklahoma.

References

- Bates, T.E. 1971. Factors affecting critical nutrient concentrations in plants and their evaluation: A review. Soil Sci. 12:116-130.
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