Reading Peanut Leaves for Future Seed Quality

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Abstract

Maturity of peanut (*Arachis hypogaea* L.) seed effects germination and potentially seedling vigor. The objective was to determine if pre-harvest tissue nutrient concentrations could predict subsequent seedling vigor. The research was a randomized complete block split block with four cultivars as main plots, three harvests as subplots, and four replications. We characterized 1) leaf and seed tissue nutrient concentrations at multiple harvest dates, 2) the vigor of subsequent peanut seed using germination rate and root characteristics , and 3) the correlation of the tissue nutrient concentrations to vigor. The trials were located in Jay, FL for three site-years during 2015 and 2016. Nutrient concentrations in leaf tissue and kernel were assessed at digging. Using the peanut profile board and the Digital Imaging Model, pods were classified as mature and immature based on mesocarp color. Vigor was evaluated using a thermal gradient table and, in 2016, rhizotron chamber tests using the rooting characteristics of subsequent seed. Leaf N tissue concentration decreased with dig dates, while Ca and Mg increased. In the kernel Mg, Zn and Mn tissue concentration all showed differences by maturity classes. No correlation was observed between maturity class and germination rate using the thermal gradient table, likely because germination capability is determined early during seed development. Although a correlation was not conclusive in this experiment, a more robust seedling vigor test may allow for the determination of in-season tissue nutrient concentrations as a predictive tool for seedling vigor in the future.

Introduction

Re-planting due to poor emergence of peanut is a costly problem for growers. The cause of poor emergence is unknown but one of the causes could be due to the quality of seed. Being an indeterminate crop, harvest date influences the amount of immature seed in the seedlot. Immature seed can influence the vigor, taste and quality of the harvest. Plants from immature peanut seed do not perform as well as plants from mature seed (Carter, et al., 2015). A previous study from Rowland, et al. (2008) found that foliar nutrient content responded to crop maturity. It was hypothesized that nutrient content in leaf and kernel tissue at harvest would be predictive of peanut seedling vigor the following season. The objectives of this study were to 1) identify tissue nutrients that could be predictive of peanut seed maturity, germination, and vigor at various harvest dates, 2) determine germination and root characteristics of peanut seed at various maturity levels, and 3) correlate tissue nutrient concentrations to peanut seedling vigor.

Methods

The experiment was conducted during three site-years in Jay, FL during 2015 and 2016 as a randomized complete block split block design with four cultivars as main plots, three harvests as subplots, and four replications. Cultivars were Georgia 06G, TUFRunner 511, FloRun 107, and UF 13303, and the three dig dates represented very early, early and optimum harvest timings. At each harvest, three pod subsamples were obtained from each plot, separated by maturity classes (brown & black mesocarps = mature, all others = immature), and used for the following analyses:

Tissue concentration: Determined on second nodal leaves immediately prior to digging and on kernel subsamples.

Thermal gradient table: A subsample was placed on a thermal gradient table to determine the cumulative germination percentage at various temperatures.

Mini-rhizotron chambers: A subsample was placed in mini-rhizotron chambers and the rooting characteristics were quantified to assess the seedling vigor (Goyzueta, et al., 2017).

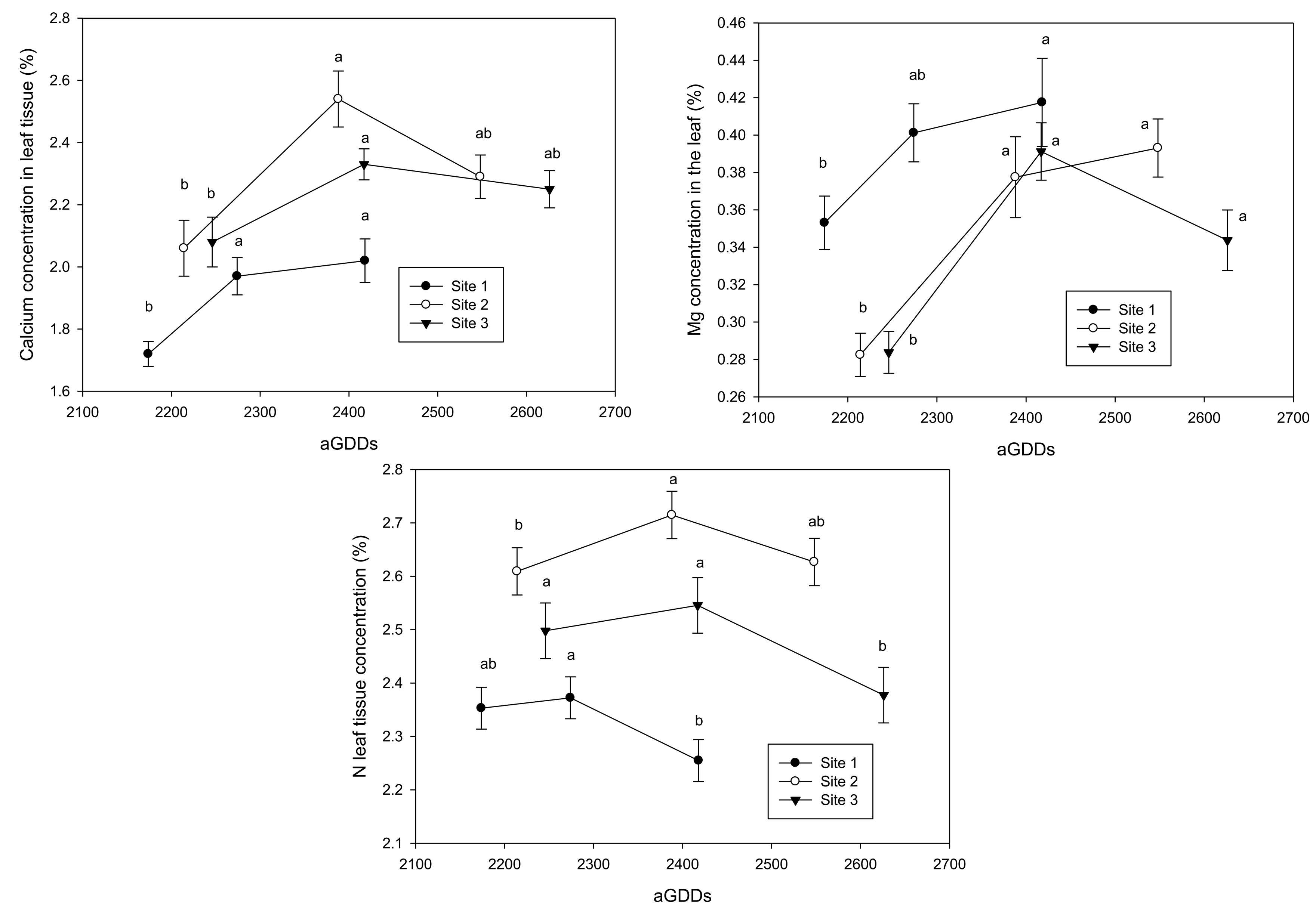


Figure 1. Leaf tissue concentrations at various harvest timings (aGDDs) and three site-years. Error bars represent standard errors of the means. Within sites, different letters represent significantly different means (P=0.05 LSD).

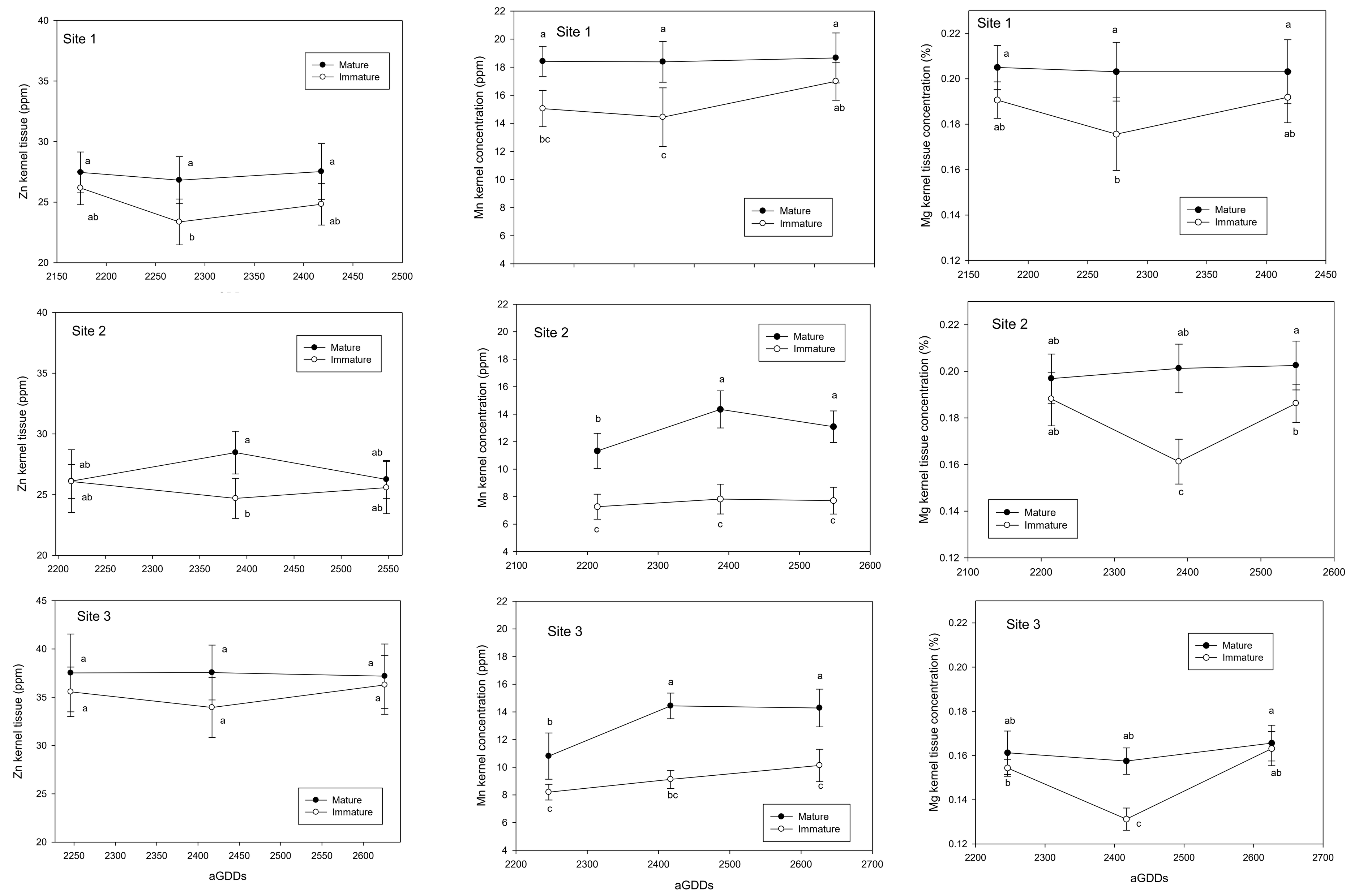
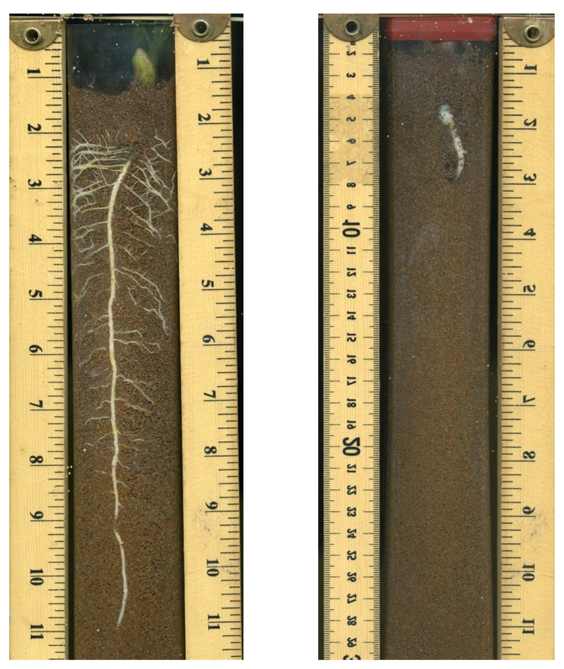


Figure 2. Kernel tissue concentrations at various harvest timings (aGDDs) during three site-years. Error bars represent standard errors of the means. Within sites, different letters represent significantly different means (P=0.05 LSD).



Mini-rhizotron chambers

Thermal gradient table

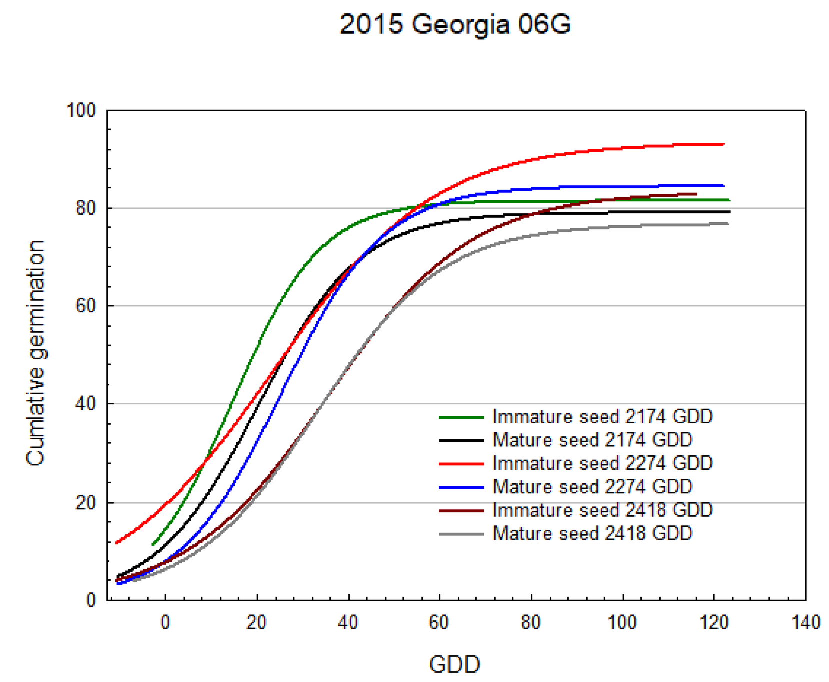


Figure 3. Cumulative germination of Georgia 06G at various dig dates after a seven day germination period at a single site-year.

Results & Discussion

Several indicator nutrients were identified in the leaf and kernel. Leaf tissue Ca concentration increased with the different harvest dates (aGDDs) during two of the three site-years reaching a maximum around 2300 to 2400 aGDDs (Figure 1). Leaf tissue Mg concentration increased with increasing aGDDs. Leaf tissue N concentration decreased over time. Both leaf tissue Mg and N responded similarly by cultivar. Kernel tissue Mg, Zn and Mn concentration differed by maturity class (Figure 2). Mg and Mn both also responded similarly by cultivar.

The determination of vigor was conducted using a thermal gradient table and mini-rhizothron chambers. Data from the thermal gradient table were not different by maturity classes (Figure 3) as the ability of a seed to germinate is determined early during seed formation. The mini-rhizotron chambers data were too variable for assessment of vigor. A correlation between nutrient concentration and seedling vigor was not possible due to highly variable vigor test data.

Conclusions

- Leaf tissue N, Ca, and Mg were identified as indicator nutrients for pod maturity
- Kernel tissue Mg, Zn, and Mn were identified as indicator nutrients for maturity class
- The thermal gradient table did not show differences by maturity classes due to the ability of an immature seed to germinate
- A correlation of seedling vigor to indicator nutrients should include another vigor test such as accelerated aging.

References

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Acknowledgements

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