Peanuts responses to potassium fertilization rates and timings depend on the soil K content

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Introduction

- Peanut (*Arachis hypogena* L.) is a vital agricultural crop in the United States (US), contributing significantly to various commodities (Arya et al., 2016).
- Farmers cultivating peanuts in leachable coarse-sandy soils often rely on fertilizers, with potassium (K) being a significant macronutrient for plant growth.
- Insufficient soil K availability can impair both yield and kernel quality, potentially reducing farmer profitability and access to favorable selling prices (El-Mageed et al., 2023; Khan et al., 2023).
- The debate about the advantages of splitting K fertilization arises from divergent outcomes attributed to variations in crops and soil types (Donaghy, 2020; Harris, 2017).
- **Objective**:
  1. To evaluate the combined effect of different rates and timings of K fertilization in locations differing in their soil K content on yield and quality traits of peanuts, and on soil's nutrient contents.
  2. Provide science-based recommendations of K fertilization that optimize yield and quality.

Methodology

- **Site:** Plant Science Research and Education Unit (PSREU) of the University of Florida during the spring-summer growing seasons of 2014 and 2015.
  - Three fields named "Hilltop," "Sesame," and "Citra" were chosen based on their Mehlich-3 soil test potassium (STK) indexes.
- **Starting Melhrich-3 soil test values:** The Hilltop site had Ca at 395.5, K at 1.6, and a Ca:K ratio of 247, while Sesame had Ca at 737.7, K at 30.7, and a Ca:K ratio of 22. Citra recorded Ca at 494.6, K at 26.4, and a Ca:K ratio of 19.5
- **Treatments and Experimental Design:** Five rates of K fertilizer (0, 56, 112, 168, and 224 kg ha^{-1} K_2O) combined with four application timings.
  - Factorial Randomized Complete Block Design (RCBD) arrangement with 4 replications.
- **Grain Yield Quality Responses:** Peanuts were harvested and quality traits were assessed, including total sound mature nuts in kernel (TSMNK) and extra-large kernel (ELK).Leaf potassium content (LKH) was analyzed at harvest.
- **Statistical Analysis:** Data analyzed in RStudio version 4.3.2

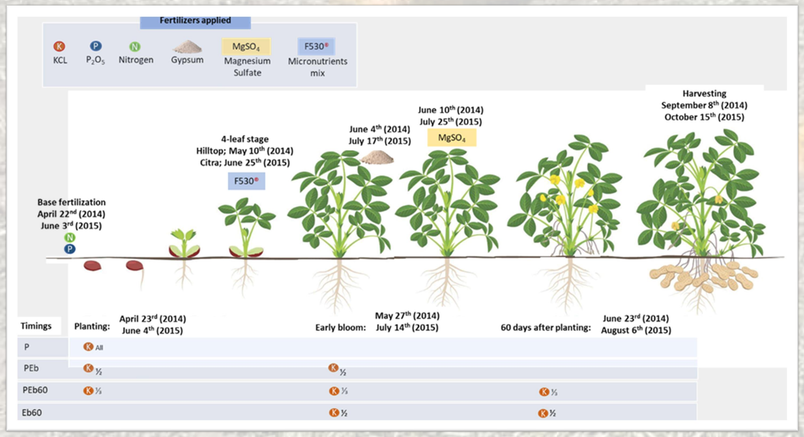

Figure 1. Fertilization treatment scheme and peanut growth and development milestones throughout the growing season.

Results

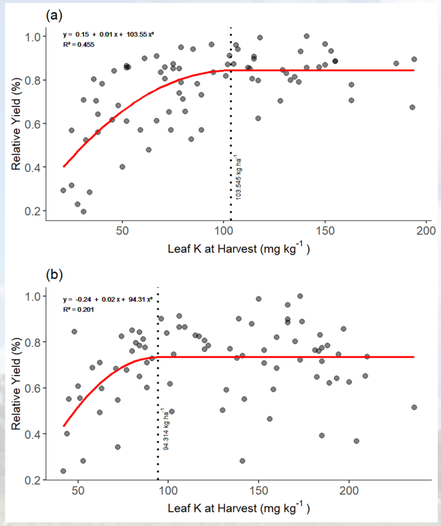

Figure 2. Regression analysis of the relation between leaf K content at harvest (LKH; mg kg^{-1}) and relative yield (%) in Hilltop (a) and in Citra (b). The break point in each regression represents the highest LKH that was likely to maximize peanuts yield.

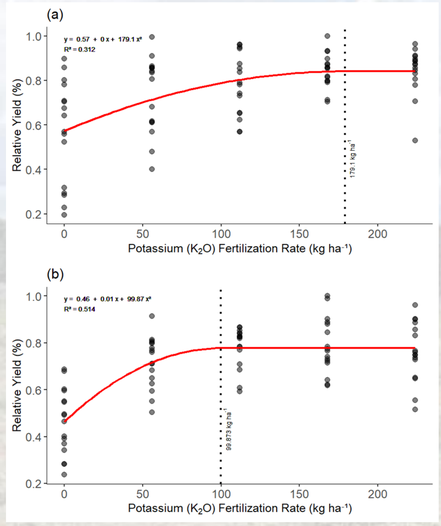

Figure 3. Regression analysis of the relation between K fertilization rate (kg ha^{-1}) and relative yield (%) in Hilltop (a) and in Citra (b). The break point in each regression represents the highest K rate that was likely to maximize peanuts yield.

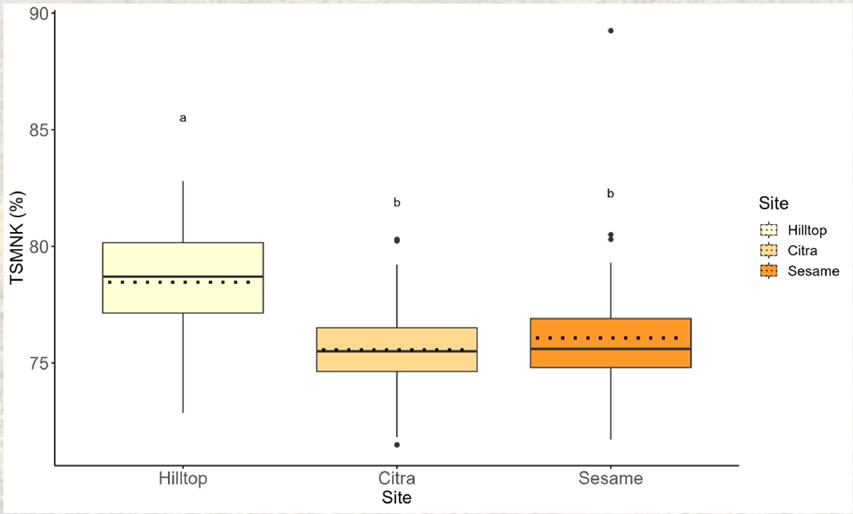

Figure 4. Total sound mature nuts kernels (TSMNK) of peanuts as affected by the effect of site.

Discussion

- **Recommended Rates:** Mylavarapu et al. (2022) suggest K fertilization rates of 45-112 kg ha^{-1}), but these may be insufficient for sandy soils with low STK (< 35 mg kg^{-1}).
  - Studies vary in recommendations, but optimal rates range from 100-179 kg ha^{-1} K_2O for maximizing yield, differing by site.
- **Potassium's Role:** Crucial for plant growth and quality, potassium affects yield, kernel size, and market value, enhancing photosynthesis and stress tolerance.
- **Nutrient Content:** Optimal K concentration in plants for yield is lower in Florida conditions than previously reported, suggesting adjusted sufficiency levels.
- **Management Recommendations:** Splitting K fertilizer not necessary; focus on rates over timing. Rates of 100-180 kg ha^{-1} K_2O recommended for maximizing yield in low-STK soils. Therefore soil availability of K is most important
  - Effective potassium management crucial for peanut yield in Florida; balancing rates with soil conditions vital for optimal results.

Conclusion

- We confirm that the yield response to increasing K fertilization rates varied based on the soil's K availability
- Neither yield nor quality attributes of peanuts were improved by K fertilization timing.
- The quality attributes of peanuts differed in the three sites and showed to be less responsive to increased K fertilizer rates
- Our results support the recommendation of a single K fertilization at planting, independently of the soil K content on sandy sites of North Florida.

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