Impact of Seed Size and Composition on Peanut Seedling Vigor: High-Throughput Phenotyping Approaches

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Project description and progress

Vigorous and rapid seedling emergence is critical for successful crop stand establishment. Seed composition traits, including oil, protein, moisture, and seed mass are known to influence seedling vigor in other crops; however, their relative importance in peanut remains unclear. This study utilized cultivars with known differences in seedling vigor to investigate the relationship between seed composition traits and seedling vigor. The cultivars included Georgia-09B and Georgia-03L in the high-vigor group; Georgia-06G, Georgia-12Y, and Georgia-20VHO in the intermediate-vigor group; and Georgia-10T and Georgia-14N in the low-vigor group. For each cultivar, seeds were classified into two size categories (small and large) based on seed width. Seeds were analyzed using QSorter to non-destructively assess oil, protein, moisture content, and seed size. After planting, plant stand count was taken at 3, 5, 8, 10, and 14 days after planting and above ground dry biomass was measured at 21 days after planting. Drone imagery was collected on the corresponding measurement days.

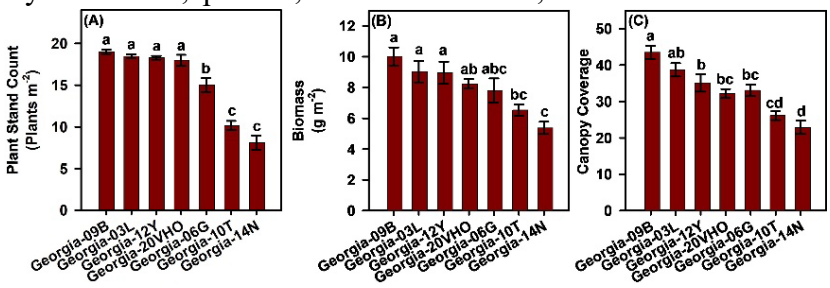

Figure 1: *Effect of cultivar on plant stand count (A), above ground dry biomass (B), and canopy coverage (C).*

We found that cultivar and seed size within cultivars significantly influenced seedling vigor, particularly plant stand count and canopy coverage. Seed composition traits showed weak or no correlations with stand count, suggesting limited influence on germination. Protein content showed the strongest positive association with seedling vigor (r = 0.72), followed by seed mass (r = 0.47). Oil and oleic acid content exhibited weak or no relationships with seedling vigor, while higher seed moisture was associated with reduced vigor (r = -0.48).

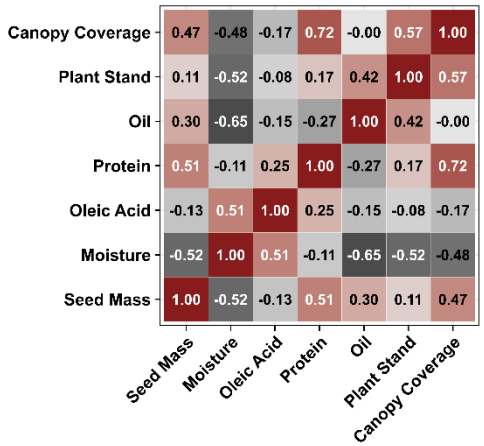

Figure 2: *Pearson correlation matrices showing relationships among seed composition traits and vigor parameters measured at 14 days after planting across peanut cultivars.*

These findings indicate that seed composition traits, particularly protein content, may serve as practical targets for improving seedling vigor independent of changes in seed size. While seed mass was positively associated with seedling vigor, seed size is constrained by grower preferences and manufacturer requirements, suggesting that improving seed composition within existing seed size classes or segregating seed lots based on composition may enhance early establishment and overall crop performance without altering seed size.