Cover Crop Species Composition and Termination Date Effects on Nutrient Cycling, Soil Water and Cotton Growth

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Highlights

- Cover crop biomass increased with each delay in termination.
- Nitrogen application reduced the amount of late-season residue for cover crops terminated at early or intermediate timings but not with late termination.
- Cotton yield was not affected by termination timing in the pea or fallow treatments, however, the latest terminated wheat (post heading) reduced subsequent cotton yield, likely due to nutrient immobilization.
- Optimum termination timing (or maturity) will depend on cover crop species and intended function.

Cover crop water-use is a common concern preventing integration in dry climates, although robust assessments have demonstrated that adequate cover crop residue (with timely termination) is more likely to improve soil water dynamics for the subsequent crop. If not due to water, documented yield loss following cover crops is then attributed to nutrient immobilization. In West Texas, wheat stubble maintained as chemical fallow may offer a cheaper and equally effective solution to preventing wind erosion and facilitating water storage. If we hope to leverage cover crop nutrient contributions though, to reduce fertilizer inputs, then the function and corresponding management practices are different. Inclusion of grass with a legume is hypothesized to facilitate a synergy of grass N scavenging and legume N fixation. The issue is the extremely competitive ability of winter cereals (especially rye), and the common occurrence of planted mixtures that are ultimately dominated by grass, leaving little to no opportunity for the key N fixing species to contribute. Earlier termination of cereal grains can minimize excessive nutrient immobilization and risk less water use, but terminating too early forfeits the benefit of residue persisting in-season. Late termination of legumes is likely to enable greater N contribution, but also greater cover crop water use. This study is informed by previous work in western Texas regarding cover cropping practices and water and nutrient relationships, with the goal to develop a best-case scenario within our environment. Therefore, the objectives of this study were to i) quantify cover crop species composition and termination timing on biomass accumulation, nutrient cycling, and water dynamics, and ii) evaluate the effect of these management options on subsequent cotton growth and yield.

- A research trial was conducted at Wall, Texas as a randomized complete bock design with four replications to evaluate cover crop treatments and management.
- Main plots compared four cover crop treatments (wheat, Austrian winter pea, wheat + winter pea mix, and no cover).
- Three cover crop termination timings determined by wheat growth stages (vegetative, boot, and anthesis) were applied as split-plots, and application of early-season fertilizer N side-dress (30 lb N ac^{-1}) *vs.* no-N fertilizer was a split-split-plot factor.

- Aboveground cover crop biomass was sampled at each termination timing. Cotton biomass and remaining aboveground cover crop residue was sampled at peak cotton growth (late-bloom).
- Soils were sampled to 24 inches soil depth at each termination timing, and at late-season cotton and residue biomass sampling for gravimetric soil water content nutrient analyses.

Cover Crop Biomass

- Wheat and the wheat-pea mix produced greater biomass than peas alone. Termination timing influenced cover crop biomass accumulation as later termination increased biomass accumulation.
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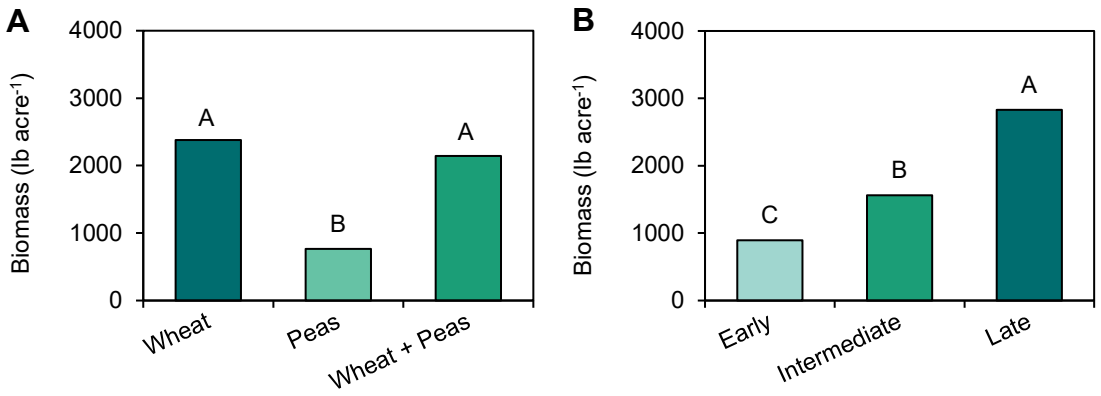

Figure 1. Measured cover crop biomass (A), and the effect of termination timing on cover crop biomass productivity (B).

Photo 1. Left to right. Wheat cover crop residue / stubble in early (1), intermediate (2) and late (3) termination timings.

Soil Water at termination

- Soil water contents (Figure 2) were similar among cover crops and fallow treatments in the uppermost soil layer (0-6"). However, soil water contents varied in 6-12", 12-18" and 18-24" soil depths.
- The fallow control retained more soil water below 6" compared to cover crop treatments with wheat.
- Rainfall in May (Figure 3) restored the soil water in upper 1ft of soil profile at late termination.

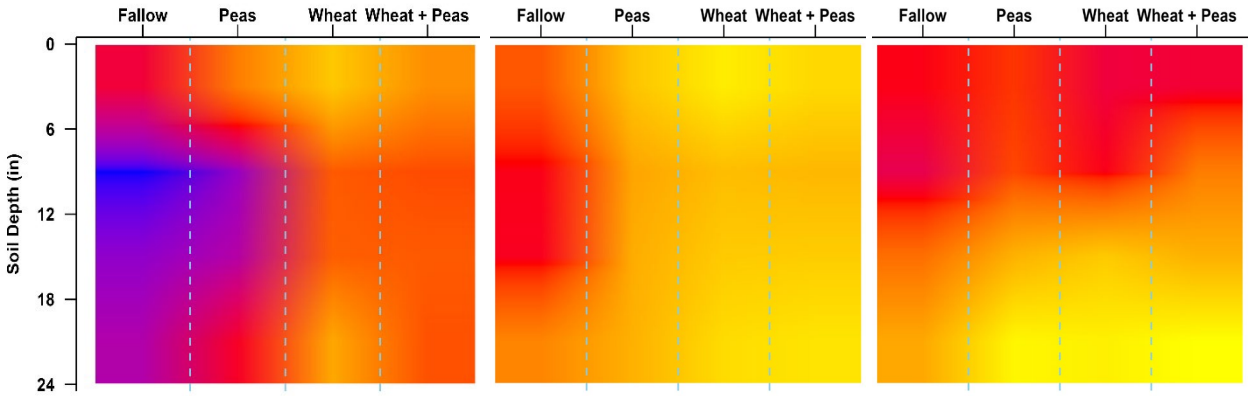

Figure 2: Soil water contents aming fallow and cover crops at early, intermediate and late temrination timings (left to right).

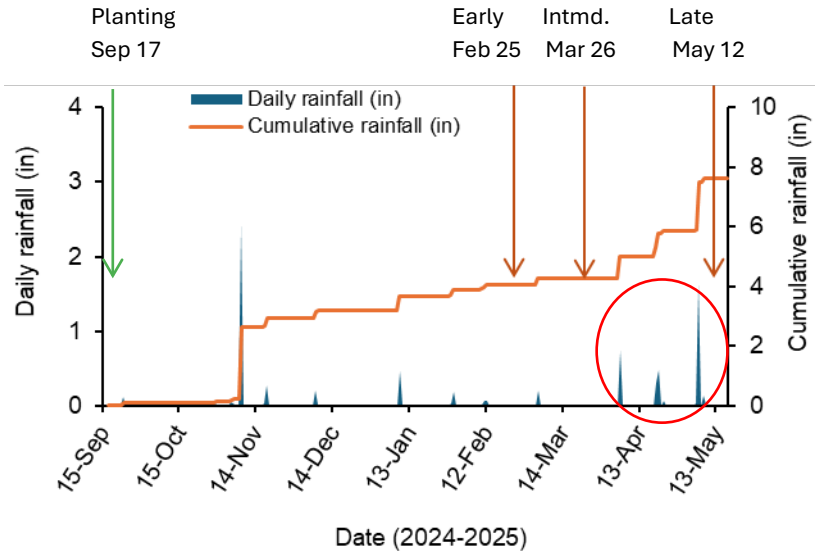

Figure 3: Daily and cumulative rainfall (in) from cover crop plantation to early, intermediate and late termination timings.

Cover Crop Residue and Cotton Biomass

- Late-season cover crop residue was affected by the interaction among wheat and wheat + pea cover crops, termination timing and fertilizer N applications.
- Wheat residue persistence was greater than the pea residue.
- Side-dressed N decreased the amount of late-season residue for early and intermediate terminations of wheat + pea cover crops (Figure 4A), and reduced cotton biomass accumulation following early termination (Figure 4B).

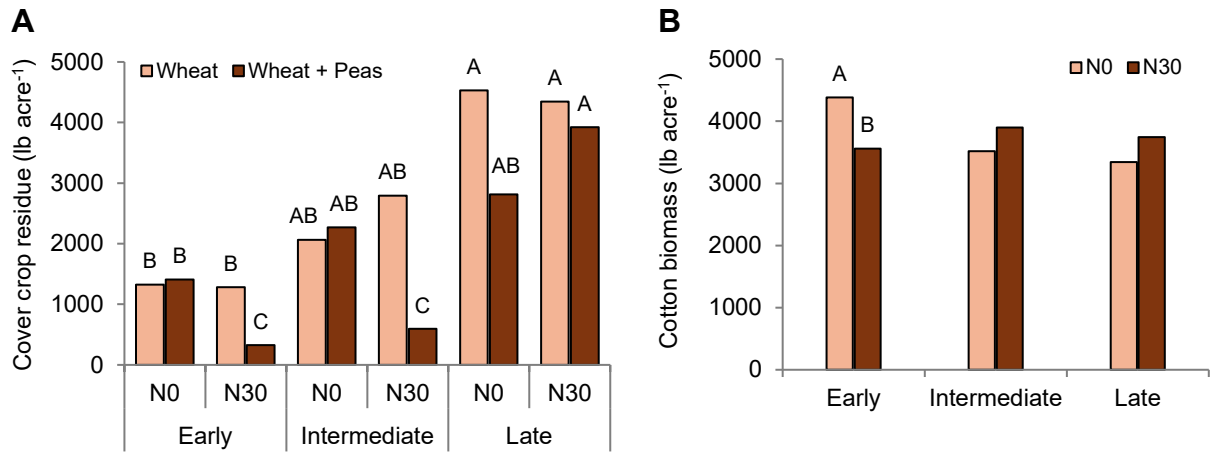

Figure 4. Interactive effects among termination timings and side-dressed N fertilizer applications for late season cover crop residue from wheat and wheat + peas cover crop mixtures **(A)** and effects of nitrogen application on late season cotton biomass under different terminations **(B)**.

Cotton Crop Health and Canopy Cover

- Cotton after wheat and wheat + peas achieved greater greenness and maximum canopy cover in fertilized plots (Figure 5).

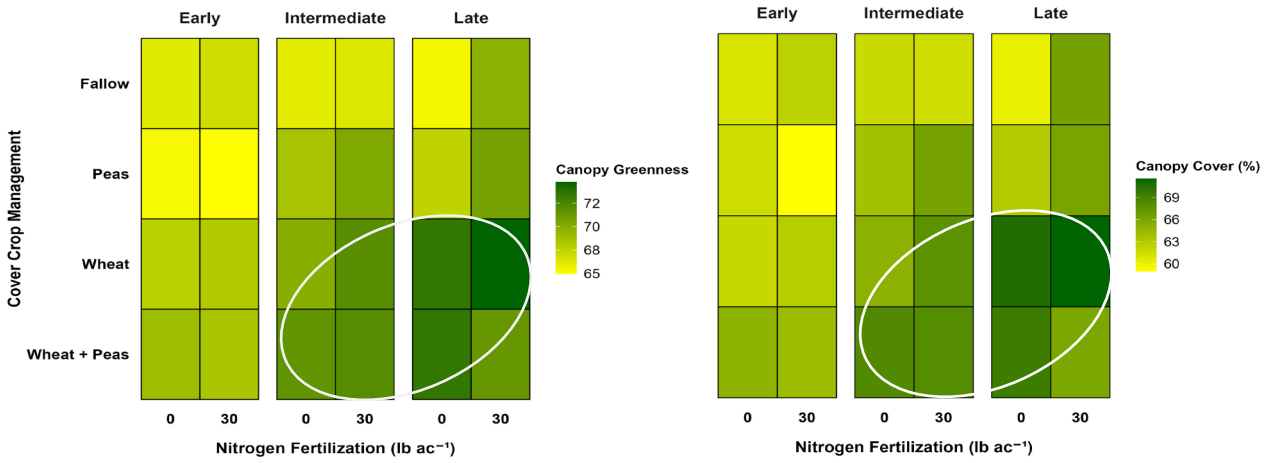

Figure 5. Cotton canopy greenness (left) and canopy cover (right)

Cotton Lint Yield

- Lint yield was affected by cover crop termination timing and the interaction between cover crops and termination timings (Figure 6).
- Lint yields did not differ among termination timings for fallow and pea treatments but yield was reduced with delayed termination of wheat and wheat + peas (Figure 6A).
- Among wheat treatments, delayed termination (intermediate and late) resulted in an 18% yield reduction compared to early termination.
- The latest termination of wheat + pea treatment resulted in 17% lower cotton lint yields than the early termination, indicating that delayed termination can negatively affect cotton performance.
- These results highlight the importance of optimizing termination timing relative to cover crop species to maximize or sustain subsequent cotton yield.

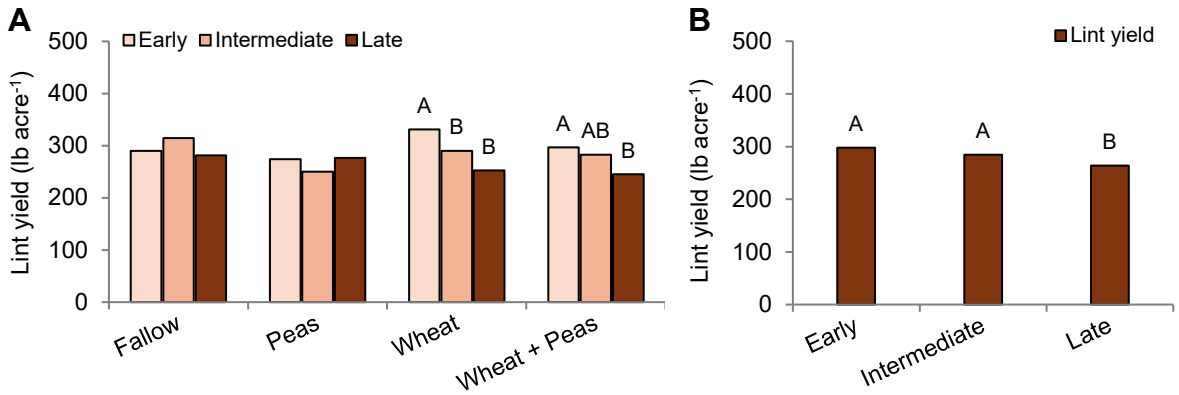

Figure 6. Cotton lint yields influenced by the interaction of fallow and cover crop treatments (wheat, peas, and wheat + peas) and different termination timings **(A)** and under the main effect of termination timings **(B)**.

Cover Crop Nitrogen Content

- Nitrogen content in wheat and peas was similar at the late termination (Figure 7).
- Wheat + pea had higher overall N content

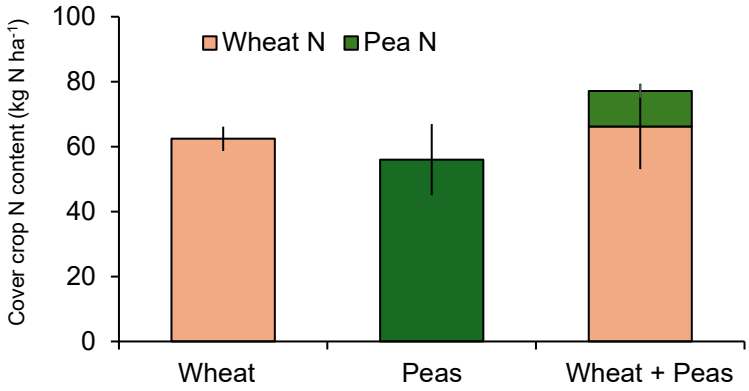

Figure 7. Nitrogen content in wheat, peas and wheat + pea cover crops at late termination.

Summary

Findings from the first year of this project highlight differences in biomass as well as timing of growth and maturity among cover crop species. These differences translated to logical effects on cotton growth and yield, demonstrating the direct risk of nutrient immobilization with increasing maturity (later termination) of cereals, while simultaneously associating no disadvantage with the latest termination of the legume. The wheat variety used in this experiment was very early maturing, and it can be inferred that a late-maturing variety could have affected the outcomes differently, particularly in a legume mix with the objective to maximize legume growth time while avoiding excessive nutrient immobilization by cereals. Currently, the practical implications of these findings are that terminating a wheat cover crop at boot did not negatively affect cotton production, although later termination did. Conversely, the earliest termination when the wheat was vegetative did not result in sufficient residue to persist into the cotton growing season. Nutrient analyses of cotton, cover crop, and soil samples from this work are being coordinated, and the work is being repeated in 2026 to develop further understanding and future direction with cover crop research in West Central Texas.

Acknowledgements

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