Maximizing Winter and Summer Legume-Grass Cover Crop Biomass in Semi-Arid Texas

Nicole Nielsen, Reagan Noland, Morgan McCulloch, Hussain Tajamul, Ryan Matsheck,

Camile Carey

Highlights

- The species-segregated planting configuration had the highest total and pea biomass with a wheat seeding rate of 150,000 seeds/ac optimizing pea biomass.
- A wheat seeding rate of 300,000 seeds/ac optimized total biomass.
- Summer-planted trials optimized total and pea biomass with the sorghum-sudangrass varieties of Super Sugar DM and Sweet Bites respectively.

Field research trials were coordinated to quantify the specific effects of legume vs. grass seeding rates and species segregation by drill-row on ultimate cover crop mixture performance for both winter and summer planted cover crops.

Winter Cover Crop

- Planting date: October 2024
- Locations: Wall and San Angelo, TX
- Treatments:
    - Razor wheat at 150, 300, 450, and 600 thousand seeds/ac
    - Austrian winter peas at 80,000 seeds/ac, inoculated with dry inoculant
- Randomized complete block designed as a 4 x 2 factorial with four replications
- Measurements: Above ground biomass by species

Winter Cover Crop

The wheat seeding rate and planting configuration both significantly affected pea aboveground biomass ($p<0.0001$ and $p<0.05$ respectively). Segregating species by row resulted in 69% greater pea aboveground biomass than their bulk planted counterpart (Fig. 2). The two lower wheat seeding rates, 150K and 300K seeds/ac, resulted in a greater aboveground pea biomass than the two higher seeding rates, 450K and 600K seeds/ac (Fig. 2).

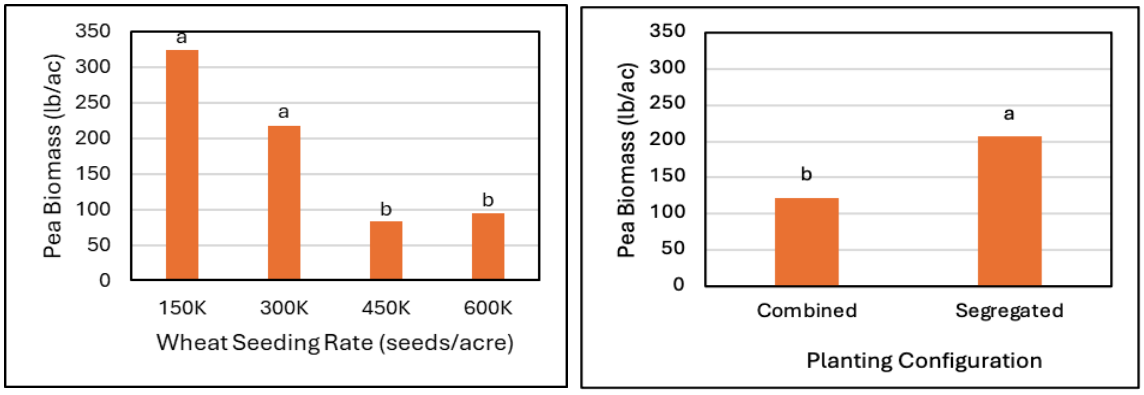

Figure 2. Winter cover crop pea aboveground biomass. Pea aboveground biomass based on wheat seeding rate (left) and planting configuration (right). Letters indicate significance between the different treatments within the chart (i.e. left or right).

Wheat seeding rate ($p<0.001$), as well as the interaction of seeding rate and planting configuration (<0.05) affected wheat biomass. Wheat seeding rate and planting configuration significantly affected the total aboveground biomass (Fig. 3). In the combined planting configuration, there was a consistent increase in total biomass in relation to wheat seeding rate, the same was not observed in the segregated planting configuration (Fig. 3).

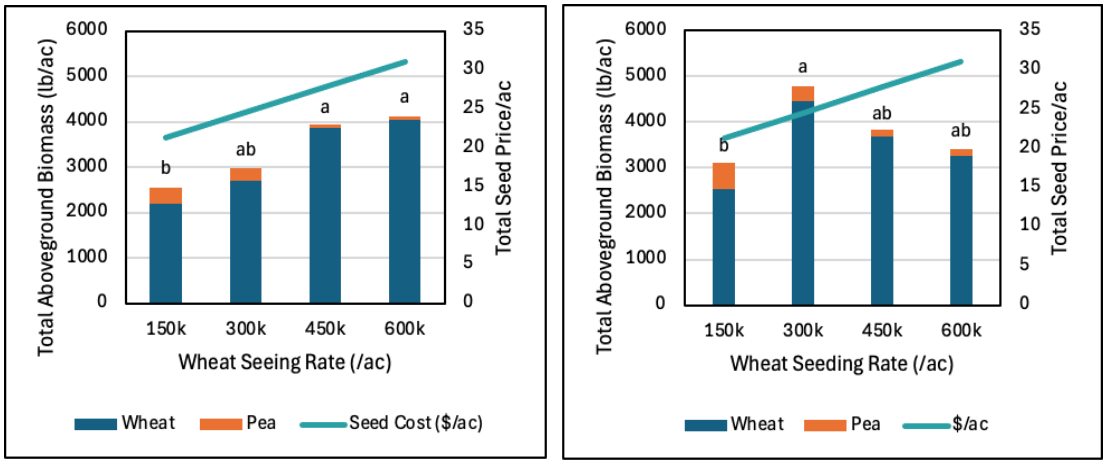

Figure 3. Winter cover crop total aboveground biomass for bulk planted (left) and segregated planted (right). Letters indicate significant differences in total aboveground biomass.

Summer Cover Crop

- Planting date: July 2025
- Locations: Wall and San Angelo, TX
- Trials: Legume Variety and Sorghum-sudangrass variety trial
- Treatments:
    - Legume Variety- ACE cowpea, Red Ripper cowpea, Iron & Clay cowpea, and Sunn hemp (20lbs/ac) with P845F sorghum-sudangrass (300,000 seeds/ac)
    - Grass varieties: P845F, Red Top Cane, Sweet Bites, and Super Sugar DM
- Randomized complete block designed as a 4 x 2 factorial with four replications
- Measurements: aboveground biomass by species

The type of sorghum-sudangrass used significantly affected the pea aboveground biomass and the grass aboveground biomass ($p<0.05$). ACE with Sweet Bites had a significantly larger pea aboveground biomass than that of the other three sorghum-sudangrass varieties but had the least total aboveground biomass (Fig. 4). ACE with Super Sugar DM had the greatest grass aboveground biomass and total aboveground biomass (Fig. 4).

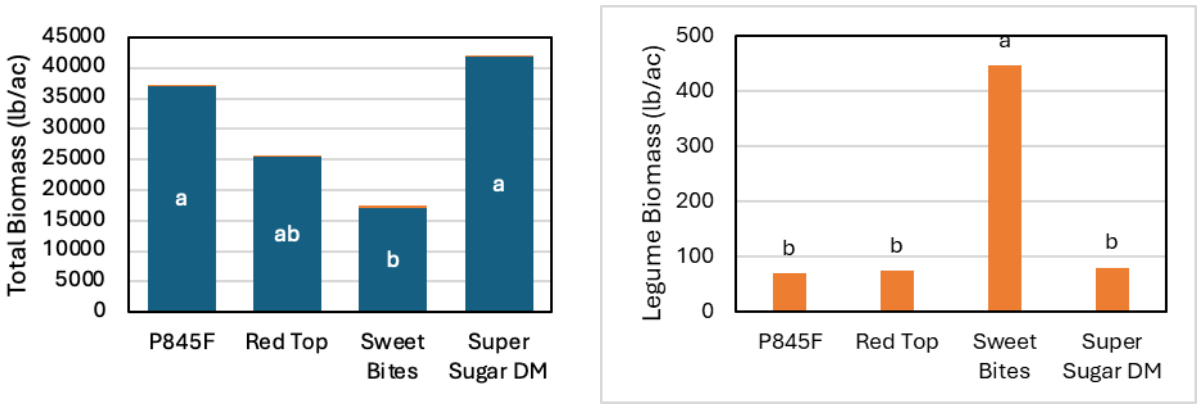

Figure 4. Total aboveground biomass (left) and pea biomass (right) for the summer sorghum-sudangrass and legume cover crop. Letters on the total biomass graph represent significant differences ($p<0.05$) in the grass biomass and letters on the pea biomass graph represent significant differences ($p<0.05$) in the pea biomass.

To optimize the potential N-fixation of a winter cover crop, these findings support the implementation of a minimal wheat seeding rate (150,000 seeds/ac) and segregated planting configuration. To maximize total aboveground biomass for grazing, a wheat seeding rate of at least 300,000 seeds/ac was needed, and the greatest grass-legume balance was achieved with the segregated planting configuration. Decreasing the wheat seeding rate evidently reduced the intraspecific resource competition, allowing the pea plants to have access to more belowground resources necessary for production. The segregated planting configuration provided pea plants with more above- and belowground space away from wheat plants, likely benefiting the peas as grasses are often more competitive for water and nutrients. This space away from the grasses gives the peas an opportunity to establish before the grasses overtake the crop, which is typically observed in cover crop mixtures. If planting in a segregated configuration is not possible, reduced wheat seeding rates were also effective to increase legume biomass. The added seed cost of wheat seeding rates exceeding 300,000 seed/ac was not justified by greater biomass. To optimize the potential N-fixation of a summer cover crop, Sweet Bites sorghum-sudangrass (the lower-yielding variety) with ACE cowpea or Red Ripper cowpea with P845F sorghum-sudangrass were needed. To optimize the total aboveground biomass for potential grazing, ACE cowpea with Super Sugar DM sorghum-sudangrass or ACE with P845F sorghum-sudangrass were needed.

Acknowledgements

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