Final Report:

Dry bean growth and development in response to cereal cover crops, soil nitrogen and water availability

Andrew Kniss
University of Wyoming, Department of Plant Sciences

Previous research has shown different effects (both positive and negative) of cover crops on dry bean yield. Cover crops have potential to provide weed suppression and agronomic benefits to dry bean producers. However, cover crops also present a source of risk, especially in water-limited growing regions. The objective of this study was to improve our understanding of the mechanism(s) by which dry bean yield is increased or decreased by cover crop use and quantifying the interaction between cover crops and soil nitrogen availability. Field studies were conducted at the Laramie Research and Extension Center in 2023 and 2024 to evaluate how shade avoidance signals (above ground) from weeds or cover crops influence dry bean response to soil nitrogen (below ground).

METHODS:

In 2023, Pinto beans ('Othello') were planted in potting media in the center of 5-gallon buckets surrounded by either grass or soil. In shade avoidance treatments, grass roots were prevented from going deep enough to reach bean roots. Nitrogen fertilizer was placed below grass rooting depth (effects of grass-reflected light and nitrogen rate were separated). The grass was removed at 3-trifoliolate bean stage, and root and shoot data were collected.

In 2024 two studies were conducted, with the study design modified slightly to ensure the quantification of root biomass and nodulation from soil-fixing bacteria. Pinto ('Othello') beans were planted in peat instead of potting media to ensure a nutrient depleted environment. The first study used the same treatments as 2023, with an added plastic root barrier to contain grass roots, and the grass was removed at the first trifoliolate bean stage. We expanded the second study and varied the inclusion of grass and the plastic root barrier, while collecting root and shoot data at the fifth trifoliolate bean stage.

RESULTS:

Results from 2023 suggest that the presence of cover crops, even if they are not allowed to use soil nitrogen, may increase the dry edible bean's need for nitrogen to maintain yield (Figures 1, 2, and 3).

Results from 2024 suggest that in the absence of cover crops, root barrier had no impact on dry bean biomass or root nodule formation. If bean roots interacted with neighbor roots, bean biomass (both root and shoot) was significantly reduced by

neighbors, but if bean roots were separated from neighbor roots, bean biomass *increased* in the presence of neighbors, and root nodulation increased significantly as well. So, although there were some minor interactions between neighbors or root barrier with nitrogen rate, the effects of nitrogen were minor compared to neighbor presence. Therefore, it appears that the presence of green cover crop or weeds during dry bean emergence and early growth may alter crop response to soil nitrogen (Figures 4, 5, 6, and 7).

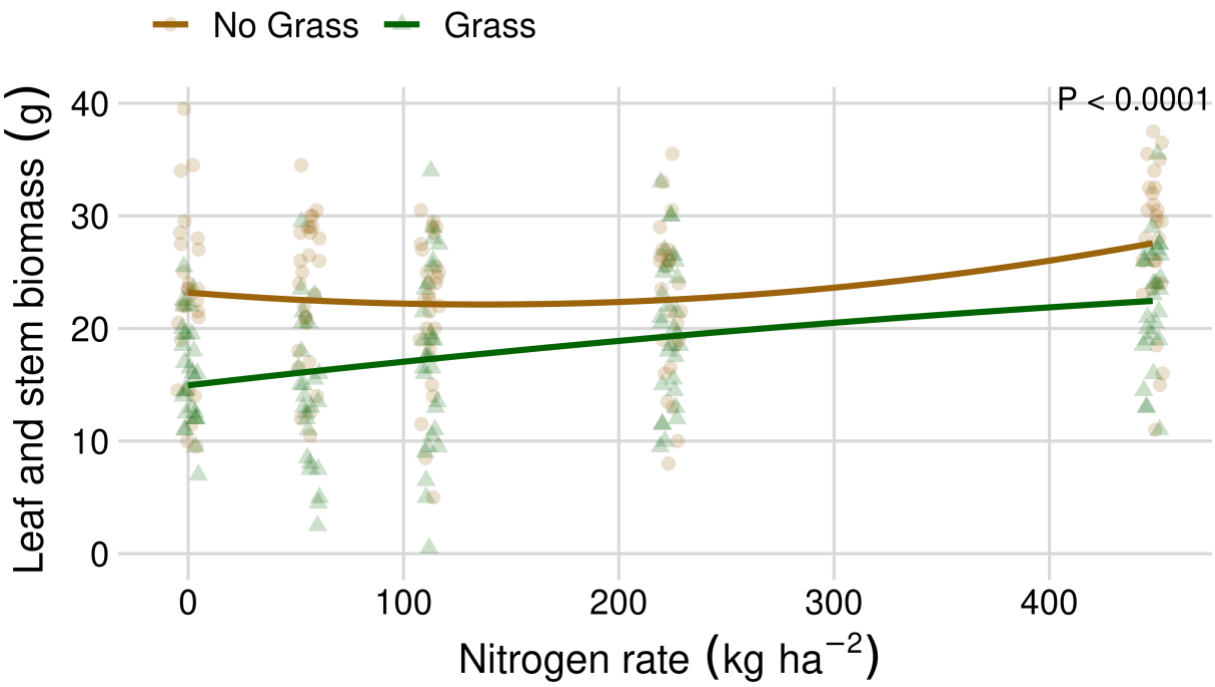

Figure 1. Cover crop's effect on dry bean's need for nitrogen in leaf and stem biomass. Laramie, Wyoming, 2023.

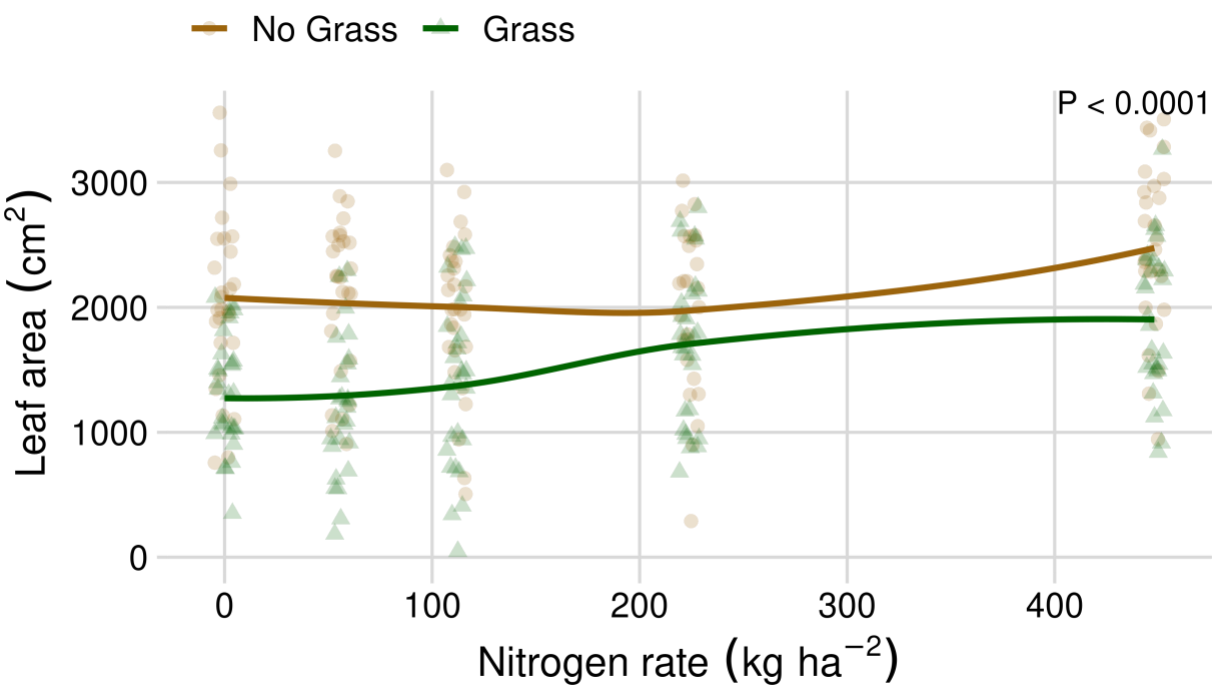

Figure 2. Cover crop's effect on dry bean's need for nitrogen in leaf area. Laramie, Wyoming, 2023.

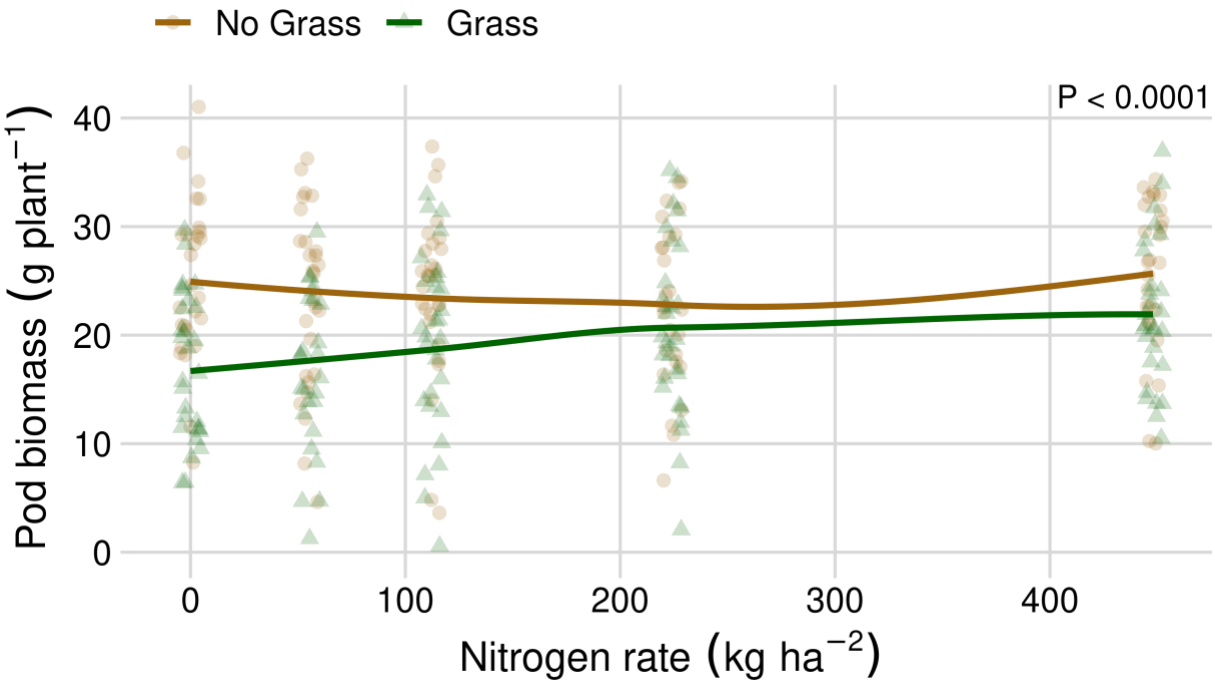

Figure 3. Cover crop's effect on dry bean's need for nitrogen in pod biomass. Laramie, Wyoming, 2023.

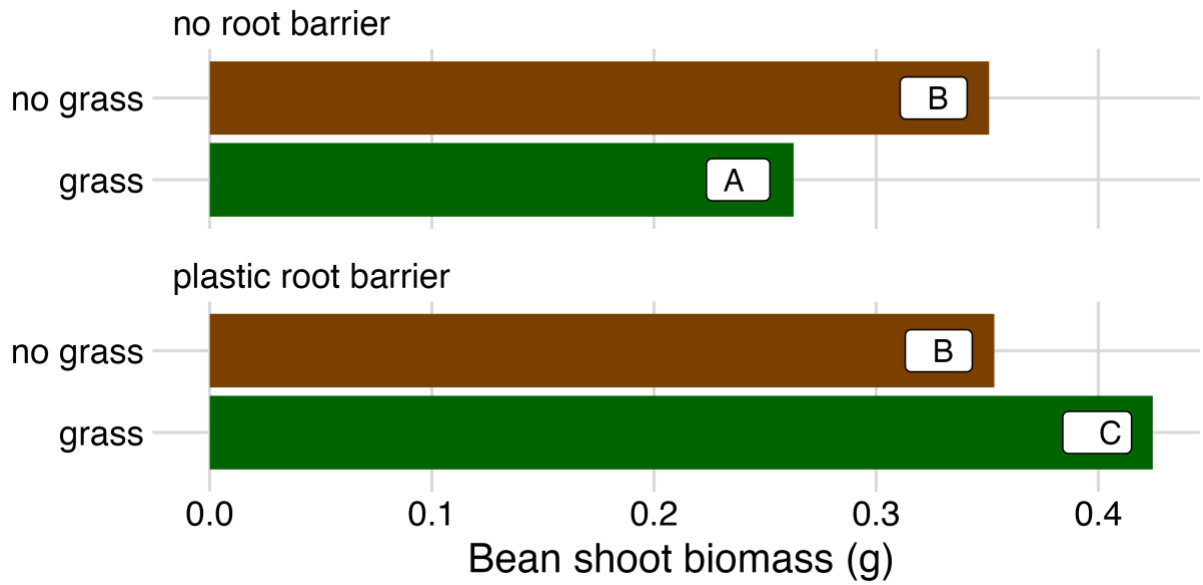

Figure 4. Effect of root barrier and cover crop on bean shoot biomass. Laramie, Wyoming, 2024.

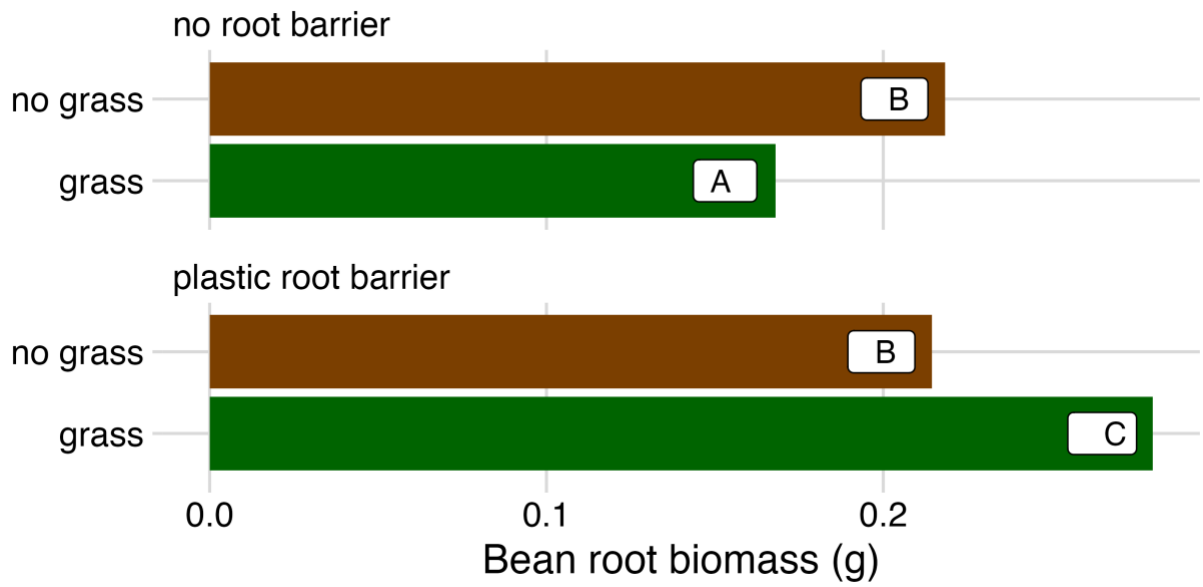

Figure 5. Effect of root barrier and cover crop on bean root biomass. Laramie, Wyoming, 2024.

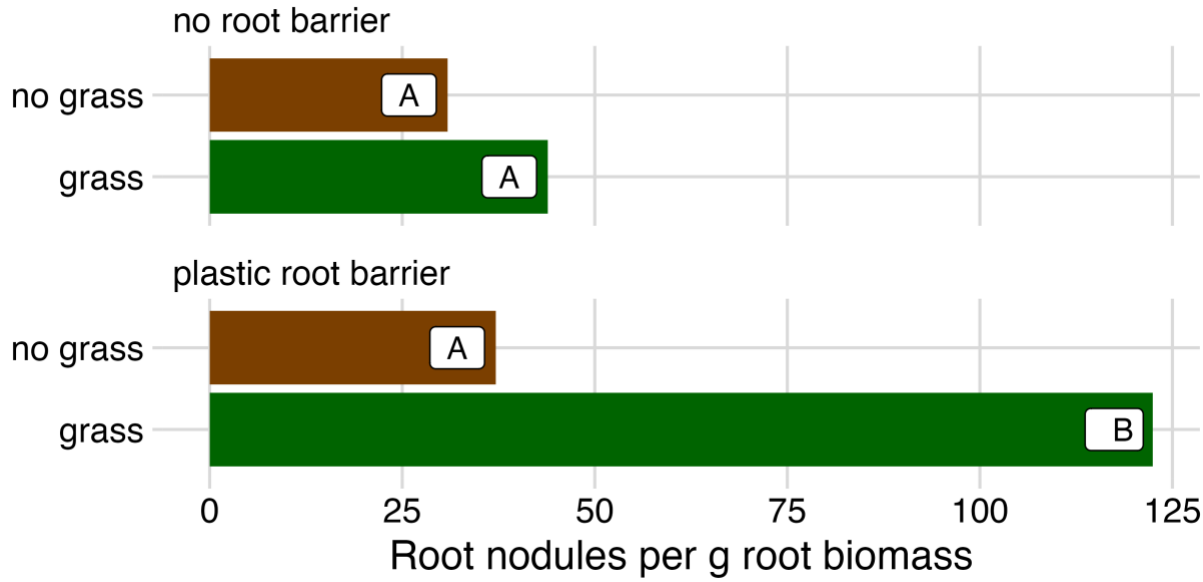

Figure 6. Effect of root barrier and cover crop on bean root nodules per g root biomass. Laramie, Wyoming, 2024.

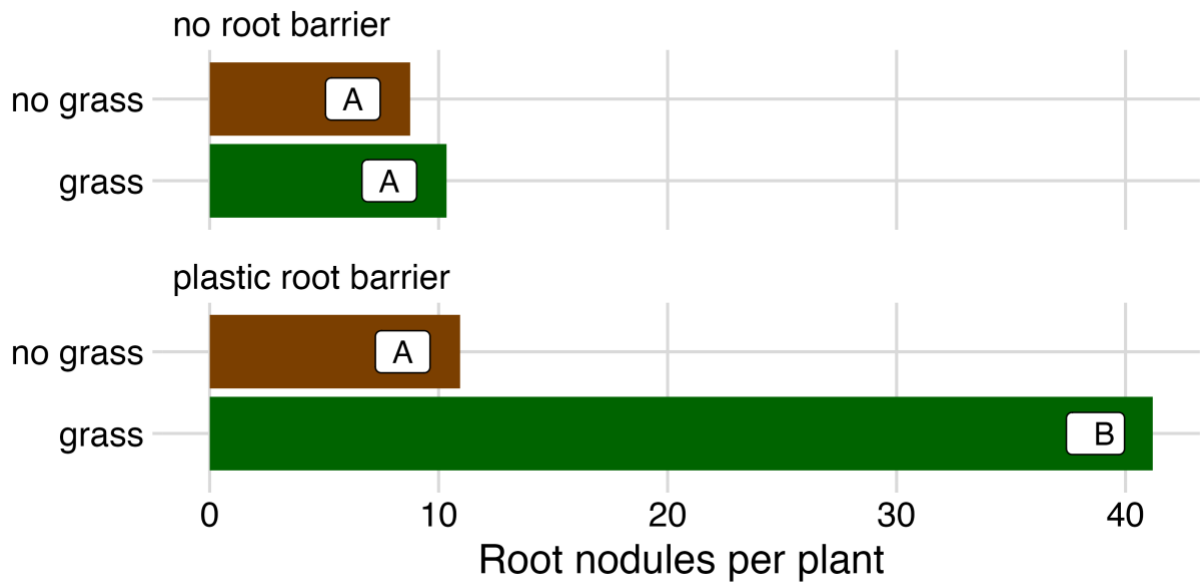

Figure 7. Effect of root barrier and cover crop on bean root nodules per plant. Laramie, Wyoming, 2024.