Final Report:

Potential for synergy between herbicides and cover crops for postemergence weed control

Madison Wright & Andrew Kniss
University of Wyoming, Department of Plant Sciences

Previous evidence suggests certain herbicides may be more effective due to the physiological response caused by a nearby cover crop. Emerging weeds can 'sense' the light reflected from cover crops and other plants and alter their growth. This phenomenon is known as shade avoidance syndrome. Shade avoidance syndrome includes a long list of physiological responses that have been well-described in some plant species like Arabidopsis but much less studied in crops like dry edible bean. Shade avoidance can result in reduced chlorophyll concentration and increased reactive oxygen within leaf tissue. The objective of this study was to investigate whether postemergence herbicide efficacy is increased due to the shade avoidance syndrome caused by cover crops. If a synergistic response between herbicides and cover crops is observed, it may allow for improved POST weed control in dry beans but may also increase the potential for crop injury from POST herbicides.

METHODS:

A field study was conducted at the James C. Hageman Sustainable Agriculture Research and Extension Center near Lingle, Wyoming, in 2023 and 2024 to evaluate POST herbicide injury beans in the presence and absence of a cover crop. The crop injury study was conducted using a split plot randomized complete block design with a winter wheat cover crop established in half the plots. Therefore, half of the dry beans in each herbicide treatment experienced shade avoidance while the other half did not. The wheat was planted in a 0.4-hectare field that was overhead irrigated with a lateral sprinkler. ‘Epoch’ Hard Red Winter Wheat was planted at 900 kilograms per hectare for both years. The whole plot was 3 meters by 9 meters and included four rows of dry beans. The half plot was 3 meters by 4.5 meters, including half of each of the four rows. Othello Pinto Beans and Montrose Pinto Beans were planted in 2023 and 2024, respectively. In both years the beans were planted at 33,000 seeds per hectare with 76-centimeter rows. POST herbicides were applied (0.5x, 1x, 2x the typical field use rate) at the 1-2 trifoliolate bean stage: Raptor (Group 2, ALS), Basagran (Group 5, PSII), and Reflex (Group 14, PPO). Weeds were removed to exclude confounding effects of weed competition. The study looked at bean stand, visual injury, SPAD (chlorophyll concentration), NDVI (light reflectance), and yield (Figures 1, 2, and 3).

In 2024 a field study was conducted at the Laramie Research & Extension Center in Laramie, Wyoming, to evaluate weed control from POST herbicides in the presence or absence of a cover crop. Common lambsquarters and kochia were planted inside the greenhouse into ‘Jiffy 7s’. Shortly after emergence, the weeds were transplanted into the field, surrounded by tilled soil or cover crops, and sprayed with 0.25x, 0.5x, 1x the typical field use rate with: Glyphosate (Group 9), Liberty (Group 10), Clarity (Group 4),

Vida (Group 14), Basagran (Group 5), and Raptor (Group 2) and assessed for injury every 7 days for a total of 21 days.

RESULTS:

Results from the crop injury study in 2023 suggest that the presence of a cover crop at bean emergence may increase crop injury from POST herbicides (Figures 1-3), but risk was low in 2024 when minimal cover crop biomass was present (Figures 4-6). No significant differences were found based on herbicide treatment in 2024. No interaction between the presence of cover crops and herbicide treatments were observed.

Results from the 2024 weed field study suggest that a cover crop does not seem to have a major impact on kochia and common lambsquarters susceptibility to POST herbicides. Both common lambsquarters and kochia had higher injury based on herbicide treatments, with both experiencing higher injury when the cover crop was present (Figures 7 and 8). This suggests additive effects rather than synergism. Glyphosate control of kochia with cover crop may be synergistic, but more work is needed to confirm.

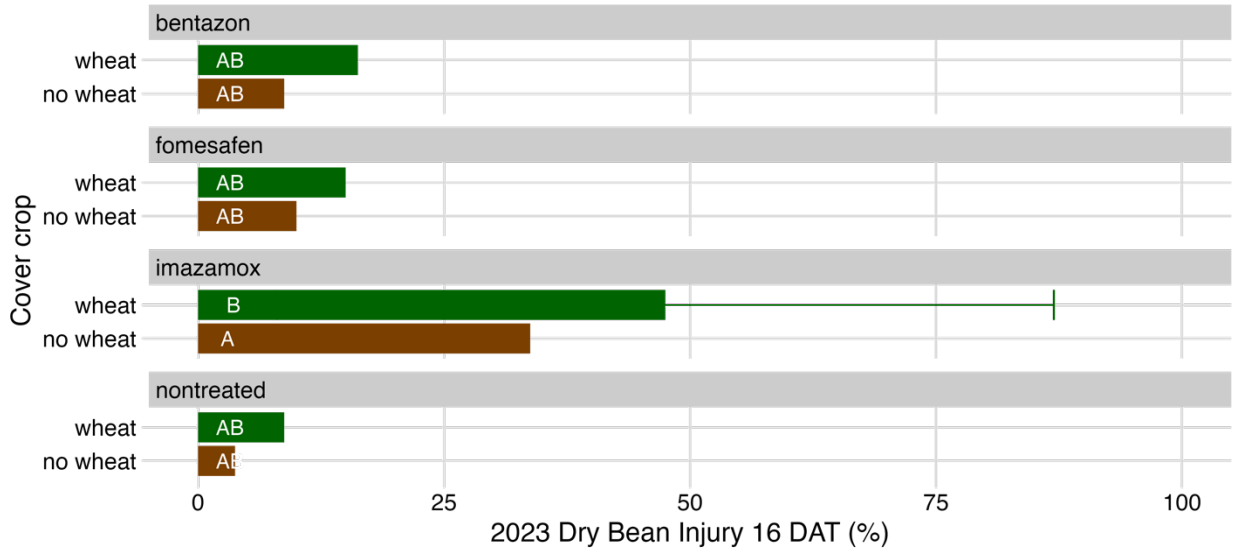


Figure 1. Dry edible bean injury 16 days after herbicide treatment (DAT) with and without the presence of winter wheat cover crop in 2023. Herbicides were applied at 0.5- to 2- times the typical field use rate; data are averaged over herbicide rate.

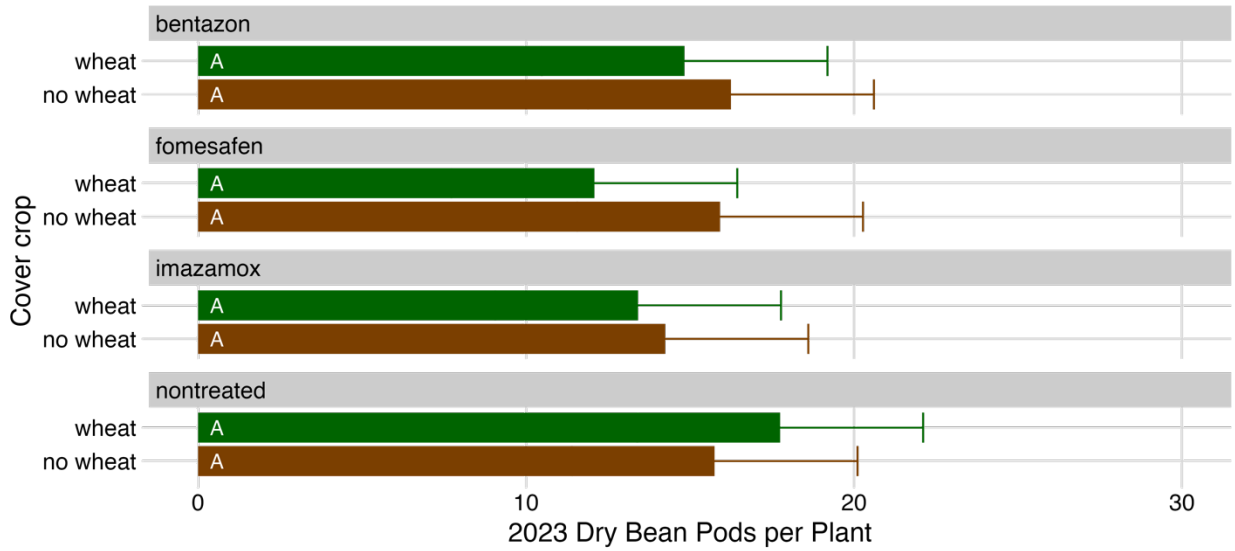


Figure 2. Dry edible bean pods per plant, averaged over 2 plants in 2023. Herbicides were applied at 0.5- to 2- times the typical field use rate; data are averaged over herbicide rate.

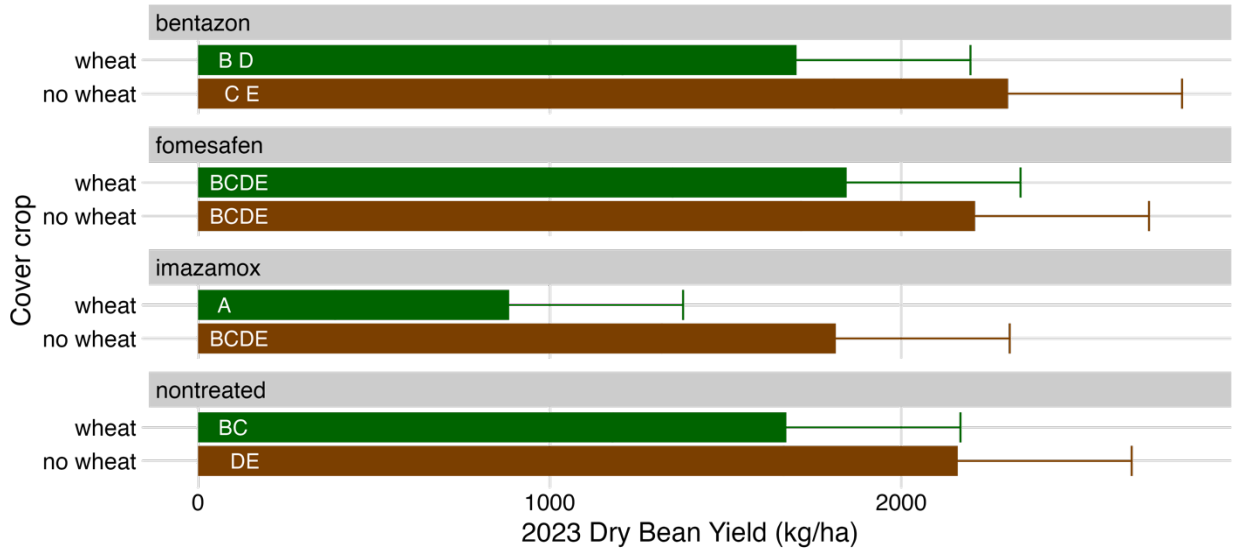


Figure 3. Dry edible bean yield in kilograms per hectare with and without the presence of winter wheat cover crop in 2023. Beans were pulled 66 days after herbicide treatment. Herbicides were applied at 0.5- to 2- times the typical field use rate; data are averaged over herbicide rate.

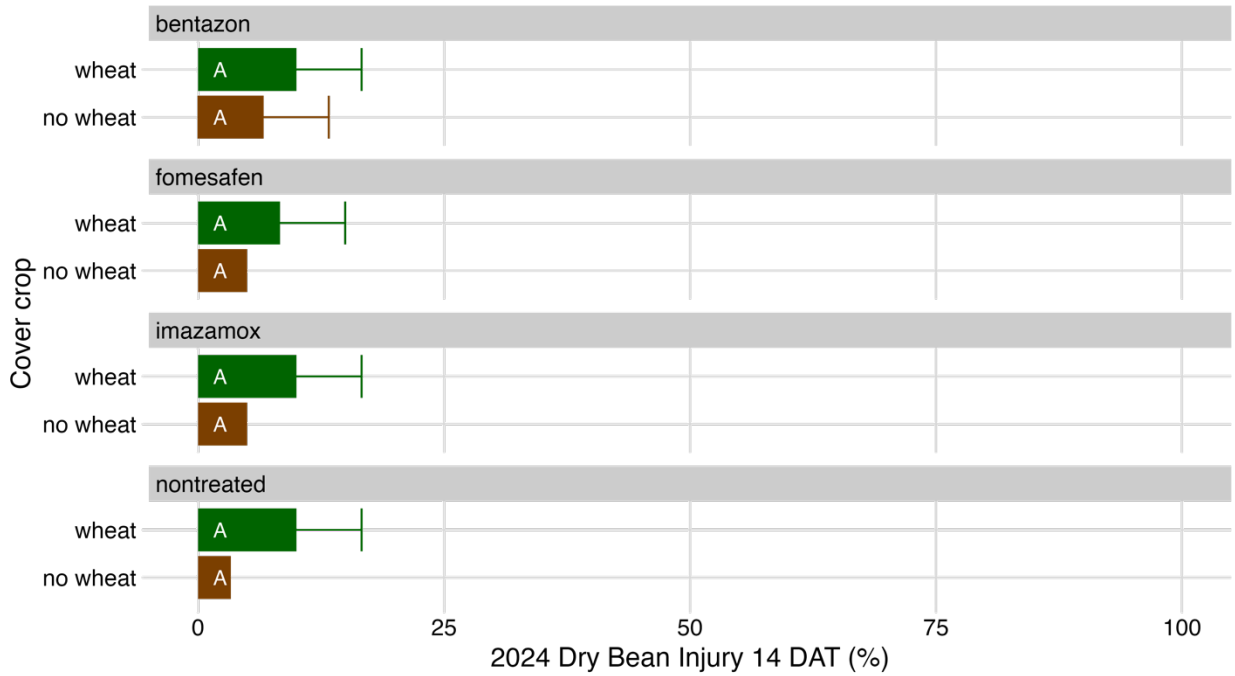


Figure 4. Dry edible bean injury 16 days after herbicide treatment (DAT) with and without the presence of winter wheat cover crop in 2024. Herbicides were applied at 0.5- to 2- times the typical field use rate; data are averaged over herbicide rate.

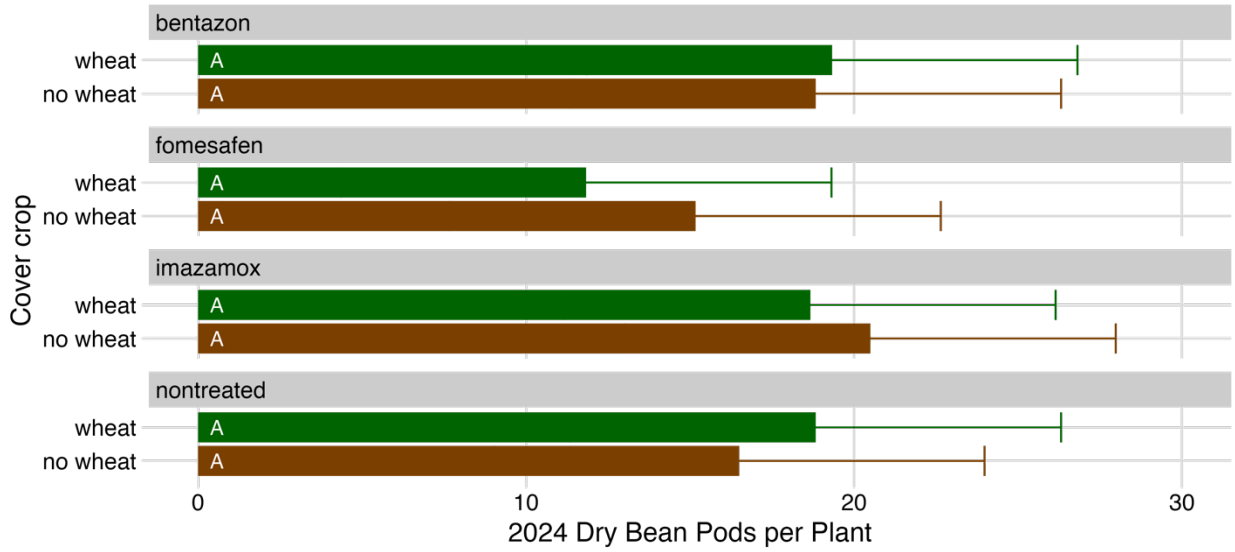


Figure 5. Dry edible bean pods per plant, averaged over 2 plants. Herbicides were applied at 0.5- to 2- times the typical field use rate; data are averaged over herbicide rate.

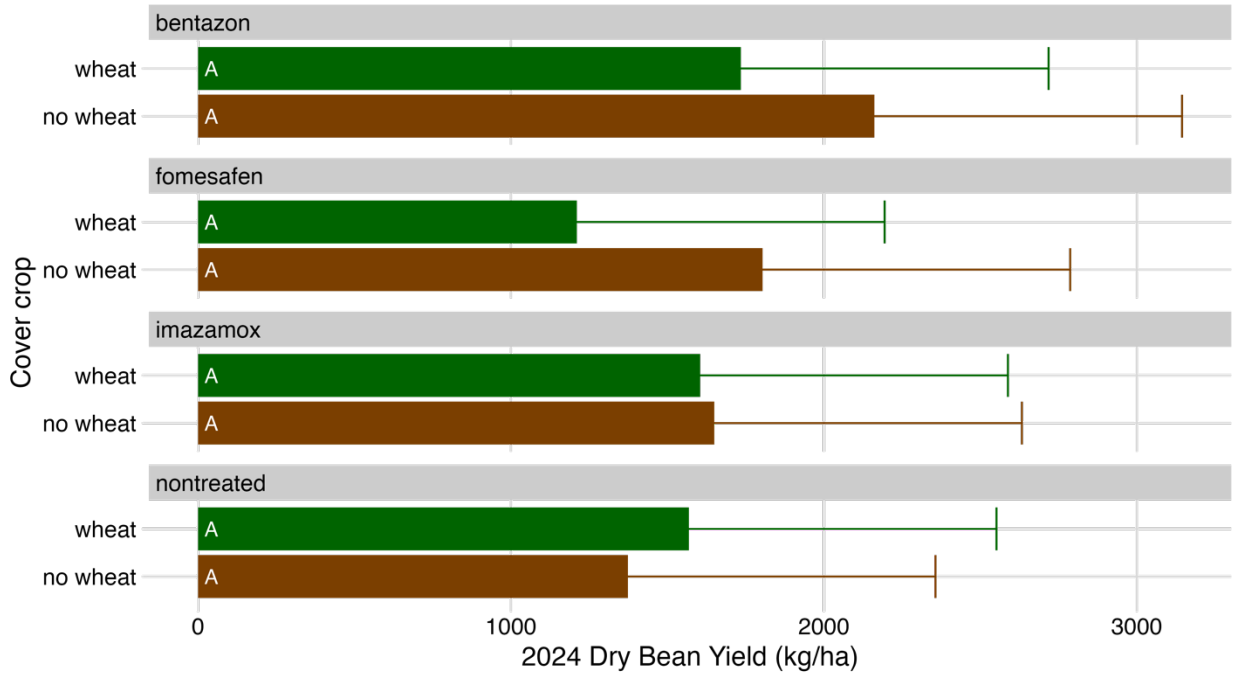
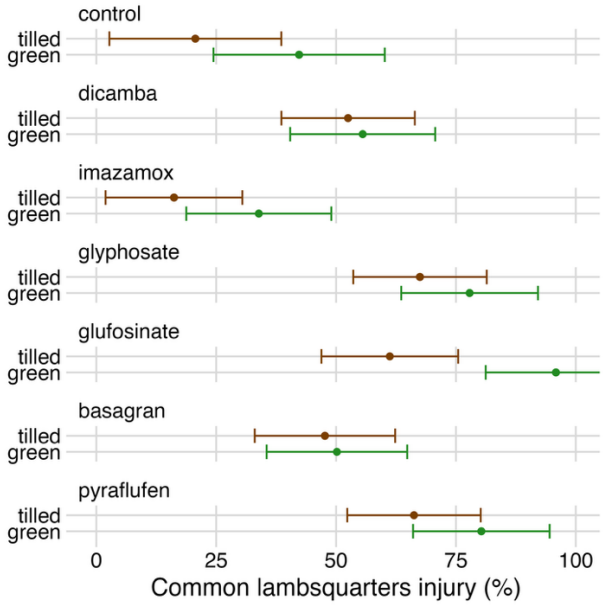


Figure 6. Dry edible bean yield in kilograms per hectare with and without the presence of winter wheat cover crop in 2024. Beans were pulled 71 days after herbicide treatment. Herbicides were applied at 0.5- to 2- times the typical field use rate; data are averaged over herbicide rate.



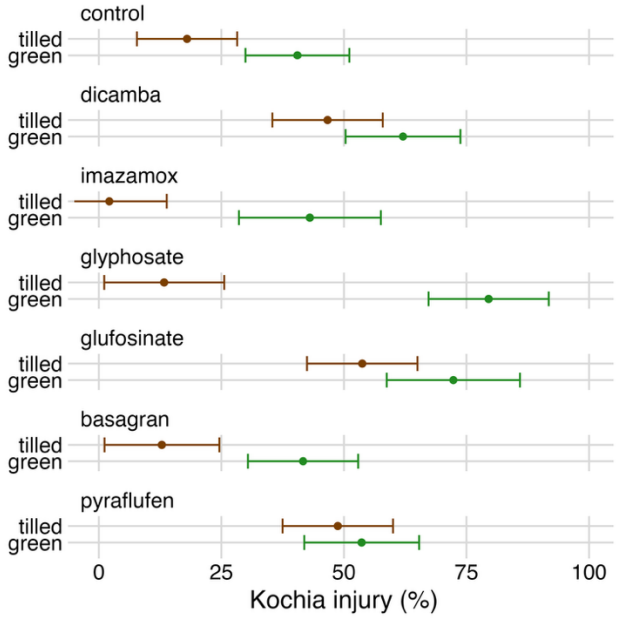
In the tilled condition:

- Raptor (imazamox) did not injure lambsquarters more than the control
- All other herbicides injured lambsquarters

In the 'green' condition:

- Cover crop without herbicide caused ~20% greater injury without herbicides
- Dicamba and basagran injury didn't increase compared to the same treatment in the tilled condition

Figure 7. Postemergence herbicide application effects on common lambsquarters in the presence and absence of a cover crop. Laramie, Wyoming, 2024.



In the tilled condition:

- Raptor (imazamox), Roundup (glyphosate) and Basagran (bentazon) did not injure kochia more than the control
- All other herbicides injured kochia

In the 'green' condition:

- Cover crop without herbicide caused ~20% greater injury without herbicides
- **Roundup caused over 75% injury of kochia in the green treatment, even though it had no effect in the tilled treatment**

Figure 8. Postemergence herbicide application effects on kochia in the presence and absence of a cover crop. Laramie, Wyoming, 2024.