

Cultural methods for improving direct harvest efficiency in dry edible bean

Andrew Kniss, Tyler Hicks, and David Claypool – Dept. of Plant Sciences, University of Wyoming

Report – February 9, 2021

Introduction:

Dry bean production in Wyoming is relatively expensive compared to other crops due to high labor, equipment, and fuel costs. A typical dry bean grower may use five to nine field operations over each acre of dry beans. Dry bean growers in Wyoming have expressed interest in direct harvest as one way to reduce the cost of dry bean production. A primary concern raised about direct harvest is the potential for harvest losses. Over the last several years, we have been working with growers and on the SAREC and Powell research farms to develop cultural practices that reduce the potential for harvest loss. We have evaluated the impact of previous crop stubble and winter planted cover crops, and both have increased harvest efficiency compared to direct harvest on tilled soil. Here, we propose evaluating the impact of different pinto bean varieties in how they respond to being seeded into a winter wheat cover crop. This knowledge will improve recommendations on best practices for direct dry bean harvest systems for Wyoming.

Project Goals & Objectives:

- *The long-term goal of this project is to evaluate different dry bean varieties for how they respond to crop residue and winter-planted cover crops in a direct-harvest system.* The specific objectives for this proposal are to:
 1. evaluate early-season node elongation for dry bean varieties in response to presence or absence of a winter wheat cover crop.
 2. measure pod height at maturity and evaluate whether early-season node heights predict bean pod height at maturity.
 3. determine the yield trade-offs (if any) from early season node extension and cover crop termination timing.

Methods:

Three dry bean cultivars were chosen based on their pod heights measured in a 2017 study funded by the Bean Commission. ‘Othello’, a commonly grown variety that has a low average pod height, ‘Lariat’, a variety commonly considered to be a ‘direct harvest’ variety due to its taller pod height, and ‘Staybright’ (formerly COSD35), a slow-darkening variety with an intermediate pod height. Field studies were conducted in 2019 and 2020. Due to COVID19 travel restrictions in 2020, early season measurements of node heights were reduced compared to 2019 (Table 1), but all major objectives were still achieved. Winter wheat cover crop was planted in early spring, and dry beans were planted near June 1. Node heights were measured near the final cover crop termination time, and pod heights were measured just before harvest. Following harvest, beans on the ground were counted in 2 m² in each plot to estimate harvest loss.

Each variety was planted into 8 different cover crop termination timing treatments. Winter wheat terminated between 30 days before planting to 28 days after planting. Wheat termination was accomplished with herbicides; glyphosate (Roundup Powermax) before dry bean emergence, and clethodim (SelectMax) after dry bean emergence. Height from the soil to 1st trifoliolate node was measured during the season, and height of the lowest and second lowest pod was measured just before harvest. Yield data was collected by direct harvesting the two middle rows with a plot combine, and harvest loss measurements made by counting beans on the ground in 2 square meters per plot after the combine had passed through.

Table 1. Measurements in 2019 and modifications for 2020.

| Measurement | 2019 | 2020 |
|--------------------------------|--|----------------------------------|
| 1st and 2nd node height | 3 plants per plot 3 consecutive weeks | Not collected |
| First trifoliolate node height | 3 plants per plot 3 consecutive weeks | 6 plants per plot collected once |
| Pod heights | 3 plants per plot collected before harvest | Same as 2019 |
| Direct harvest yield | Harvested with plot combine | Same as 2019 |
| Harvest loss | Counted dropped beans | Same as 2019 |

Results:

A hail storm shortly after bean planting reduced dry bean stand significantly in 2019 (from approximately 75,000 plants/acre to just 53,000 plants/acre. This low bean density may have affected several of the response variables, including harvest losses and bean pod height, since high bean densities are likely to further increase bean height. In 2020, dry bean stand averaged 97,000 plants per acre for Othello, 98,000 plants per acre for Staybright, and 104,000 plants per acre for Lariat.

When the cover crop was terminated well before dry bean planting, trifoliolate heights ranged from 6.6 cm (2.6 inches) to 9 cm (3.5 inches) depending on year and variety. As expected, Lariat had the tallest node heights in both years (Figures 1 & 2). Although trifoliolate node height is not particularly useful from an agronomic perspective, our work suggests it is a useful measurement to evaluate when the dry bean plants are modifying their growth in response to the cover crop. Trifoliolate node height correlates reasonably well with late season pod heights. In both years, we observed the first trifoliolate node increase in height if the winter wheat cover crop was terminated later than 2 days after planting (Figures 1 & 2). If the cover crop is terminated later than 2 days after planting, dry bean will alter its growth to grow taller in response to the competition from the wheat.

At harvest, pod heights followed a similar pattern as early season node heights for all varieties except Staybright in 2020, which did not appear to respond to cover crop termination timings (Figures 3 & 4). As expected, Lariat held its pods highest off the ground, with the lowest pod averaging 2.3 to 2.7 cm (0.9 to 1.1 inches) off the ground in 2019 and 2020, respectively. Othello only held its lowest pods 0.1 to 0.5 cm off the ground (less than 0.25 inches), and a high proportion of Othello plants had bean pods laying on the soil surface in both years. Termination timing more than 4 days after planting tended to increase dry bean pod height for Othello, but Lariat and Staybright were more variable, requiring termination times ranging from 4 to 10 days depending on the year.

In 2019, harvest loss (expressed as percent of beans left behind the combine) was unaffected by wheat termination timing, but the varieties had substantially different loss estimates (Figure 5). Lariat had the lowest harvest loss at 6.9%, followed by Staybright at 7.8%. Othello harvest losses were 19.9%, more than twice as high as either of the other two varieties. In 2020, the ranking of varieties was similar with Othello having much greater harvest loss compared to the other two varieties, but the wheat termination timing affected harvest loss estimates. For all three varieties, harvest loss decreased if wheat was terminated after dry bean planting (Figure 6).

Even though Othello had substantially higher harvest loss compared to the other varieties in both years, Othello had the highest harvested yields in both years; 2,100 kg/ha (1,900 lbs/A) in 2019 (Figure 7) and

3,500 kg ha (3,100 lbs/A) in 2020 (Figure 8). Lariat and Staybright harvested yields were 9 to 17% less than Othello, even though the harvest losses were less than half of Othello. Yield of Lariat, the tallest variety, was reduced if wheat was terminated 1 to 4 days after dry bean planting. Othello, the shortest variety, maintained yield in 2019 as long as wheat was terminated by 10 days after planting. However, Othello yield was reduced if wheat was terminated less than 8 days *before* planting in 2020.

Results from 2019 suggested there might be a window between 2 to 10 days after dry bean planting to terminate a cover crop that would increase pod heights without reducing dry bean yield potential. Based on 2020 results, this window is likely much narrower. In general, we recommend that the winter wheat cover crop be terminated no later than 2 days after dry bean planting to ensure yield potential is maintained. Terminating the cover crop more than 10 days after planting is very likely to result in dry bean yield reduction.

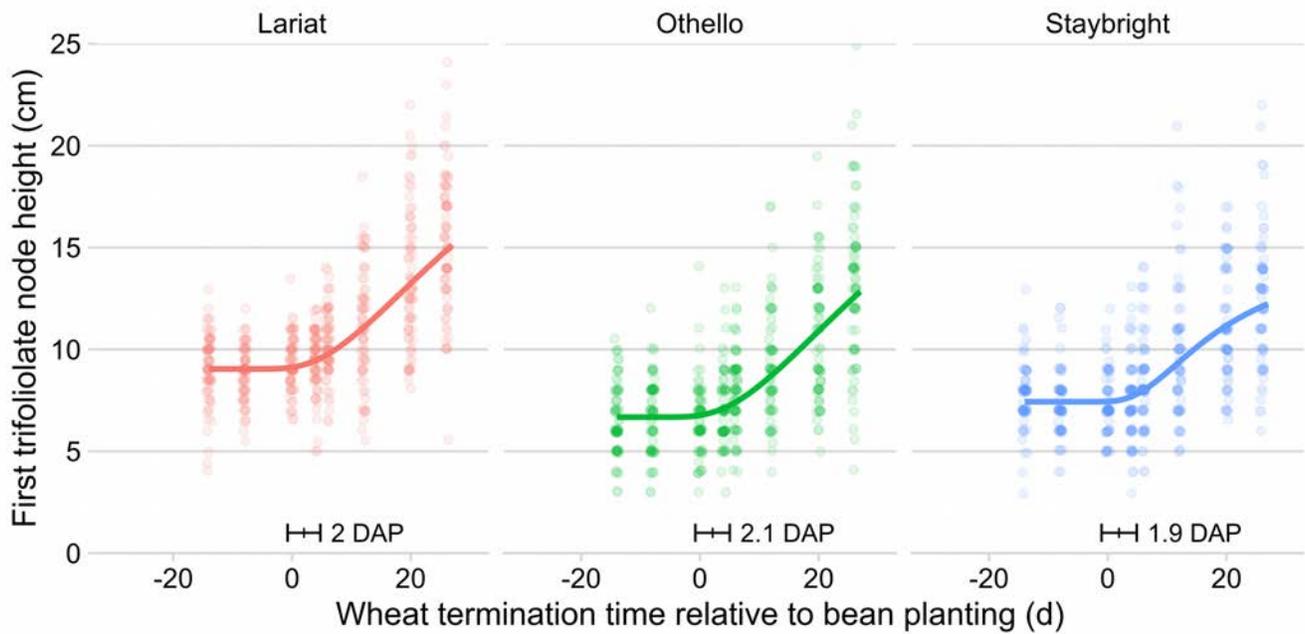


Figure 1. First trifoliolate node height for three dry bean varieties as affected by winter wheat cover crop termination time, Lingle, WY 2019.

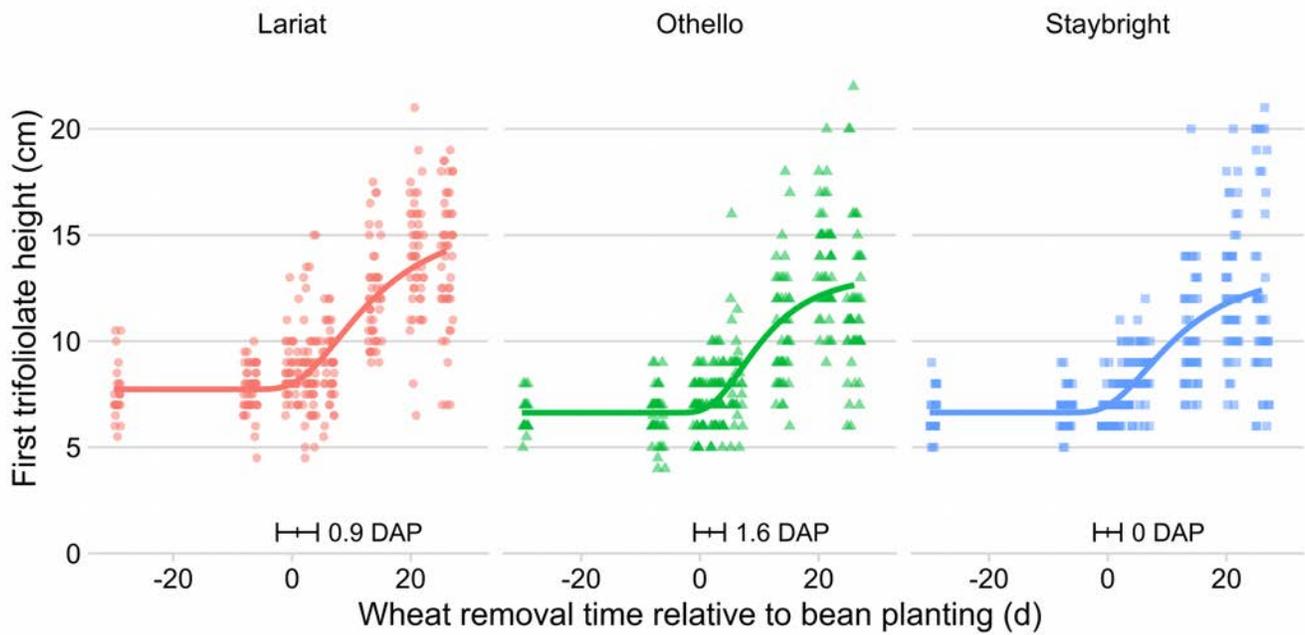


Figure 2. First trifoliolate node height for three dry bean varieties as affected by winter wheat cover crop termination time, Lingle, WY 2020.

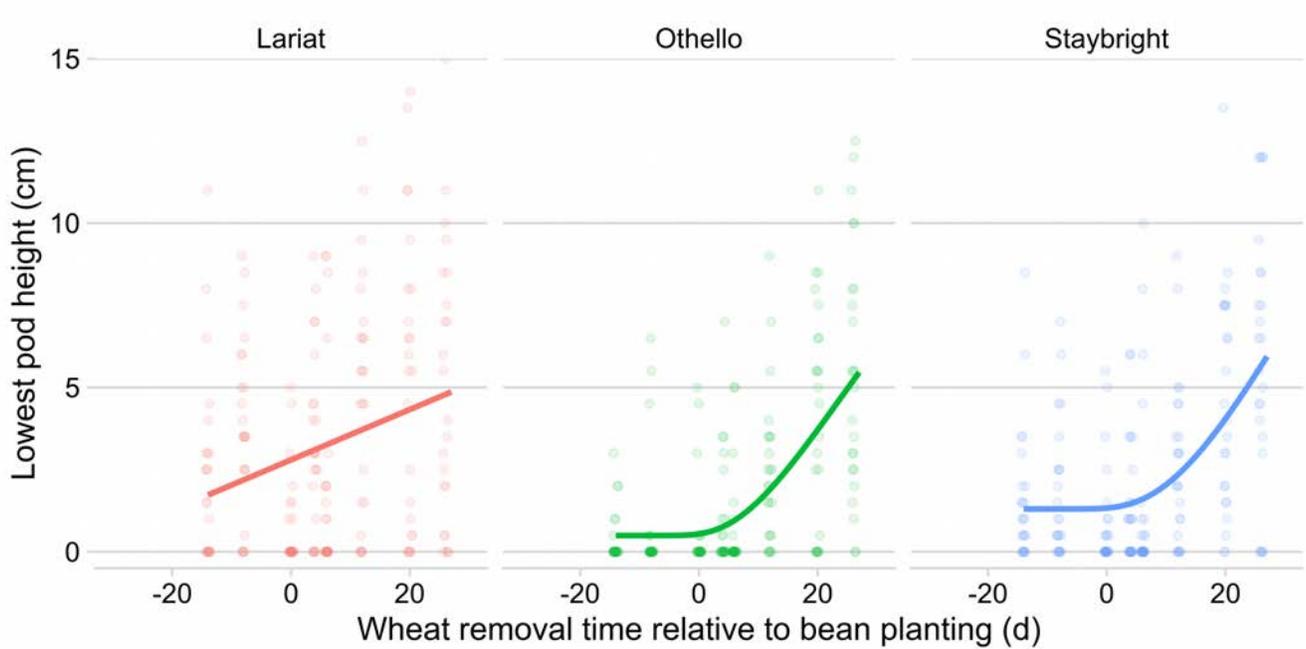


Figure 3. Lowest pod height at harvest for three varieties as affected by winter wheat cover crop termination time, Lingle, WY 2019.

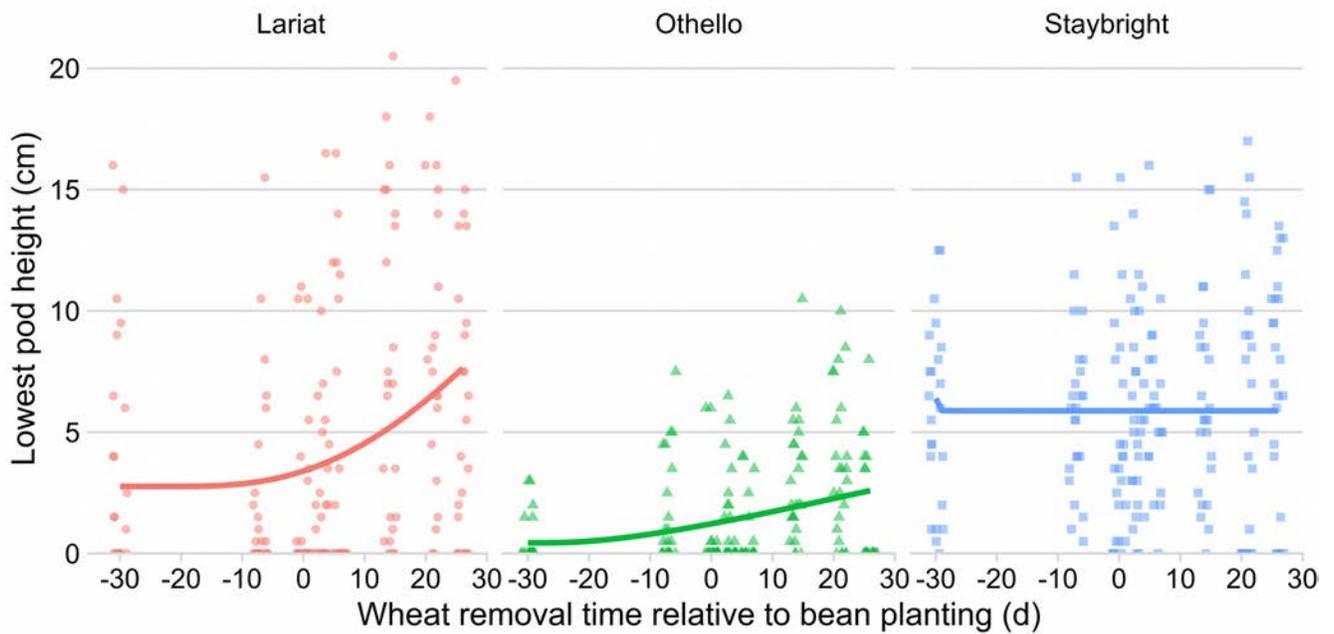


Figure 4. Lowest pod height at harvest for three varieties as affected by winter wheat cover crop termination time, Lingle, WY 2020.



Figure 5. Harvest loss for three varieties as affected by winter wheat cover crop termination time, Lingle, WY 2019.

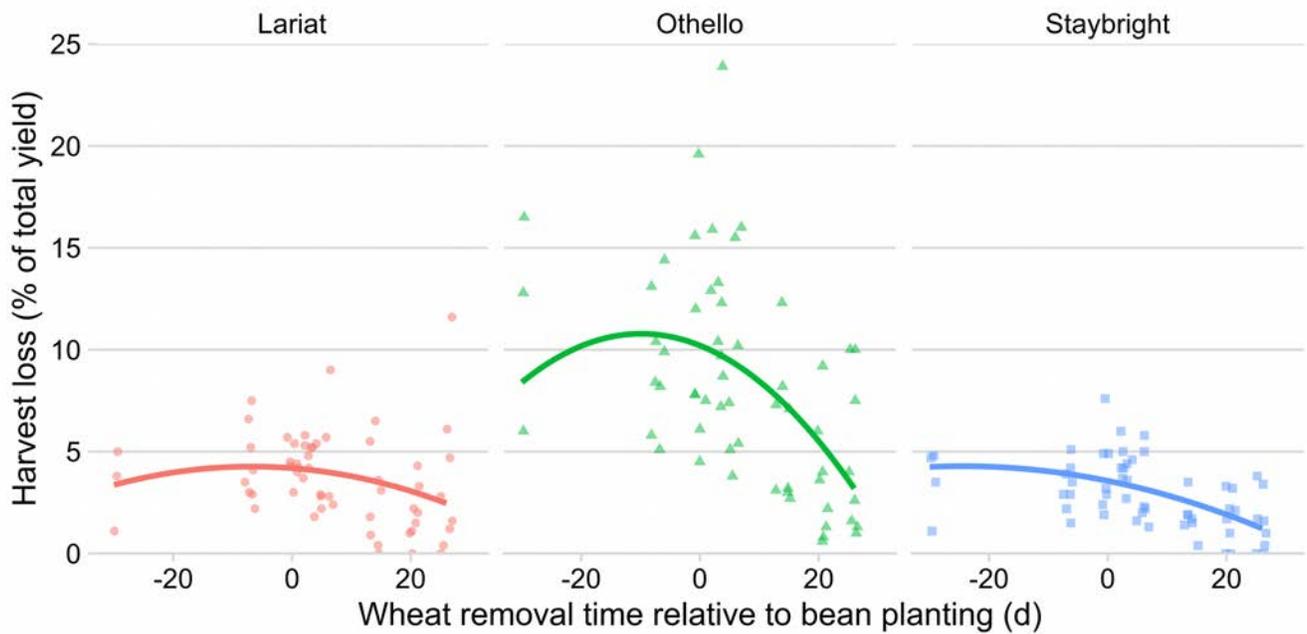


Figure 6. Harvest loss for three varieties as affected by winter wheat cover crop termination time, Lingle, WY 2020.

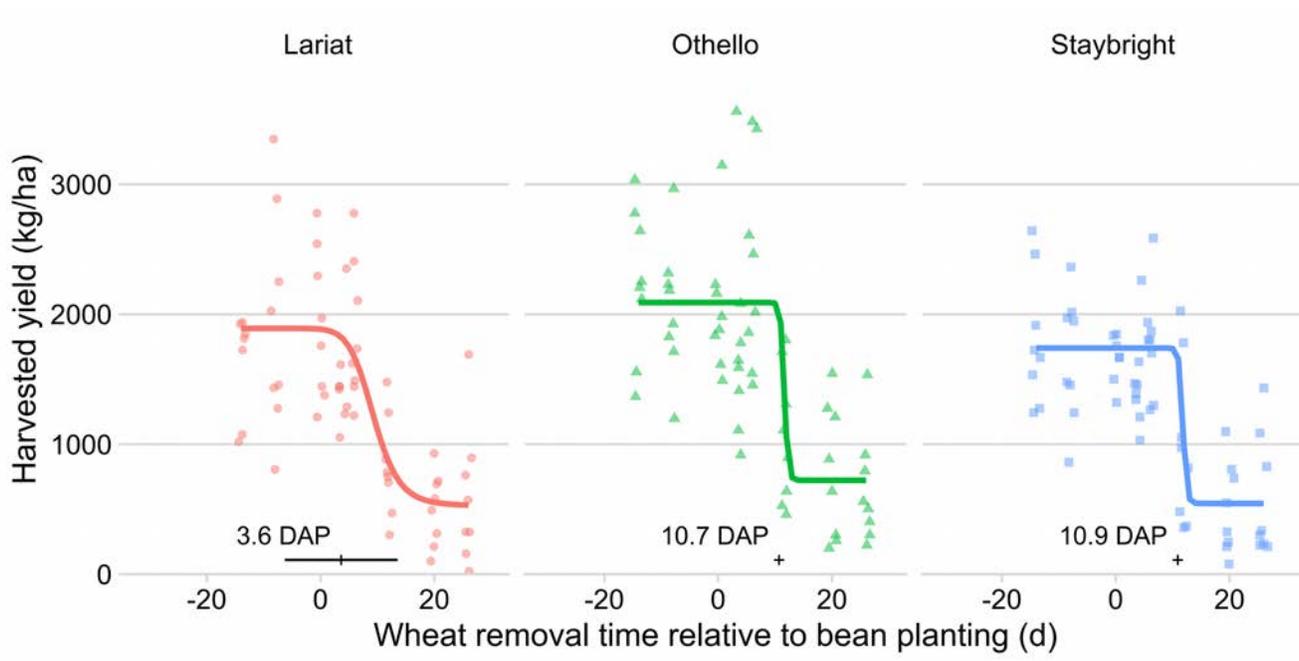


Figure 7. Harvested dry bean yield for three varieties as affected by winter wheat cover crop termination time, Lingle, WY 2019.

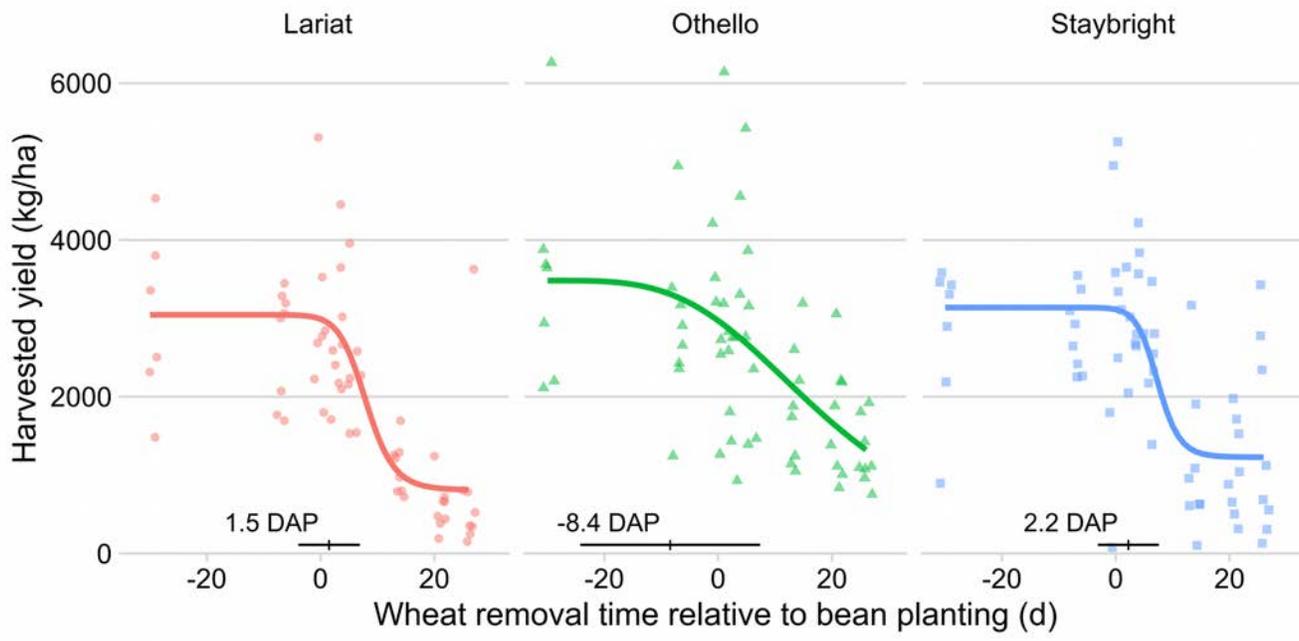


Figure 8. Harvested dry bean yield for three varieties as affected by winter wheat cover crop termination time, Lingle, WY 2020.