Edible Dry Beans as Part of Improved Crop Rotations in Wyoming

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Introduction
Crop rotations in Wyoming's irrigated production areas are changing rapidly as marked increases in sugar beet yields reduce the acreage needed to supply sugar refineries. Wyoming sugar beet acreage has declined by nearly half in recent years, while edible dry beans have seen a 20% increase in acreage from the 1990s to present. The shift in crop rotations coincides with steady transition from furrow irrigation to overhead sprinklers, which creates opportunities for conservation tillage systems; however, dry bean production practices that include undercutting for harvest are not suitable for conservation-oriented strategies. Reduced- or zero-tillage practices combined with direct harvest create much less soil disturbance than the approaches typically used in Wyoming, but information about the growth and yield of different dry bean varieties under different tillage and irrigation practices is needed.

Objectives
Our objectives are to evaluate growth and yield of four dry bean varieties within a sugar beet–dry bean–barley rotation under (1) conservation and typical tillage management; and (2) typical full irrigation and 75% of full irrigation.

Materials and Methods
For the first year of this anticipated three-year study, four varieties of edible dry beans were planted on June 1, 2017, under a lateral-move overhead sprinkler at the Powell Research and Extension Center (PREC). One six-row strip (22-inch rows) of each variety was planted within each of four treatments: (1) conventional till/full irrigation; (2) conventional till/limited irrigation; (3) minimum till/full irrigation; and (4) minimum till/limited irrigation. The study was embedded in the bean phase of a long-term sugar beet–dry bean–barley rotation study that began in 2014. Varieties included COSD-7 (now called Sundance), Windbreaker, Monterrey, and Poncho, which were selected to represent varieties known to be both suitable and unsuitable for direct harvest as part of the minimum-till system. Strips were divided into three 60-foot-long subplots within each of the two tillage-by-irrigation treatments (4 varieties × 4 treatments × 3 subplots equal 48 plots total) (Table 1; Fig. 1).

Results and Discussion
Under conventional tillage, Poncho beans yielded the best under both full and limited irrigation levels (Fig. 1). Under limited irrigation in the conventional tillage treatment, Poncho exceeded yields of the other varieties under full irrigation except for COSD-7. The minimum-till plots were impacted by excessive weeds that affected growth and yield traits. Under limited irrigation, Monterrey and Windbreaker beans produced statistically similar yields in the minimum tillage treatment as they did under conventional tillage. Canopy temperatures ranged from 91 to 95°F on July 2 and were not impacted by varieties or treatments. Plant height in mid-August generally reflected yields, but was not impacted as much by tillage or irrigation level. Total above-ground plant biomass was fairly even within tillage treatments, but the weight of pods in the early maturing variety Poncho was almost twice as high as the other varieties. In summary, deficit irrigation and minimum tillage reduced grain yield in 2017. Although we expected the upright varieties (COSD-7, Monterrey, and Windbreaker) to perform better than the prostrate variety (Poncho) under minimum tillage, that was not the case.

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**Table 1.** Tillage operations in the long-term (since 2014) tillage by irrigation study at PREC in which the current dry bean variety study was embedded into the earlier study.

<table>
<thead>
<tr>
<th></th>
<th>Sugarbeet</th>
<th>Dry Bean</th>
<th>Malt Barley</th>
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</thead>
<tbody>
<tr>
<td><strong>Conventional Tillage (CT)</strong></td>
<td><strong>Previous Fall</strong> (after barley): Moldboard plow to ~9 inches. Level with mulcher × 2.#</td>
<td><strong>Previous Fall</strong> (after beet): Moldboard plow to ~9 in. Deep rip following beets if compaction detected. Level with mulcher × 2.</td>
<td><strong>Previous Fall</strong> (after bean): Moldboard plow to ~9 in. Level with mulcher × 2.</td>
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<tr>
<td></td>
<td><strong>Spring:</strong> Disc to incorporate fertilizer.</td>
<td><strong>Spring:</strong> Incorporate fertilizer.</td>
<td><strong>Spring:</strong> Disc to incorporate fertilizer.</td>
</tr>
<tr>
<td><strong>Minimum Till (MT)</strong></td>
<td><strong>Previous Fall:</strong> None, or strip-till to prep seedbed.</td>
<td><strong>Previous Fall:</strong> None, or strip-till to accommodate barley drill. Deep rip following beets if compaction detected.</td>
<td><strong>Previous Fall:</strong> None, or strip-till to accommodate barley drill.</td>
</tr>
<tr>
<td></td>
<td><strong>Spring:</strong> Strip-till following broadcast fertilizer.</td>
<td><strong>Spring:</strong> No-till.</td>
<td><strong>Spring:</strong> No-till.</td>
</tr>
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</table>

# × 2 means that this operation was done twice.

**Figure 1.** Yields of variety by tillage and irrigation (full and deficit irrigation). Error bars indicate standard error (n=3). Different letters indicate significant differences within tillage levels at the p<0.1 level.