Crop Response to Nitrogen and Phosphorus Fertilizer in Sugarbeet/Bean/Barley Rotations under Conservation Tillage and Limited Irrigation

J.B. Norton¹, O. Ng’etich¹, U. Norton², J. Vardiman³, and C. Carter³

As producers convert flood systems to overhead sprinklers and conventional tillage practices to conservation tillage methods, new approaches to soil fertility management are needed. Improved control over water application leads to less nutrient loss, while increased soil organic matter (SOM) from conservation tillage increases water- and nutrient-supplying potential of soils. Both present opportunities for improved crop nutrient management, but altering irrigation and tillage without changing fertilizer practices can reduce yield and quality of crops such as sugarbeet and malting barley from over-supply of nitrogen (N). Phosphorus (P) fertilizer management on calcareous soils is also a long-term issue for Wyoming producers and could be affected by management changes. Also, many Wyoming production areas do not receive adequate irrigation water for whole growing seasons. Improved understanding of interactions among conservation tillage, water supply and use, and nutrient management are needed.

Objectives
Evaluate sugarbeet, dry bean, and malt barley response to five levels of N fertilizer and five levels of P fertilizer under: 1) conservation and typical tillage management; 2) typical full irrigation and 75% of full irrigation, and 3) combinations of fertilizer, tillage, and irrigation treatments (interactions).

Materials and Methods
The study began in 2014 with establishment of four replicated plots of 1) two tillage approaches (reduced till and conventional till), 2) two irrigation levels (full irrigation as typically applied at the Powell Research and Extension Center [PREC] and 3/4 irrigation), 3) three crops (sugarbeet, barley, and dry beans), 4) five levels of N fertilizer, and 5) five levels of P fertilizer. (A separate study in the same framework will evaluate effects of a mixed cover crop following barley.)

Results and Discussion
Fertilization studies often show no results during the first year because of high variability associated with residual N and P from previous years. This was the case for this study for N, P, tillage, and irrigation level in beans and barley, and for P and tillage approach in sugarbeet. But we did see a significant response to N in sugarbeet when averaged across tillage and irrigation treatments (Figure 1). These early results indicate that application of more than 150 pounds of N per acre did not increase yield of roots or sugar, but this could change with more data from 2015 and 2016. Sugarbeet yield also responded to irrigation level, with the lower level yielding 24.9 pounds per acre and the higher level yielding only 17.2 lbs/ac averaged across fertility and tillage treatments. Lower yield from

¹Department of Ecosystem Science and Management; ²Department of Plant Sciences; ³University of Wyoming Extension.
more irrigation water suggests that in 2014 the higher irrigation level may have leached nutrients below the root zone. This indicates the importance of proper irrigation water management for optimal yield. Starting with the 2015 growing season, we are using weather and crop information to precisely apply water to meet the needs of crops, and we’ll also use 3/4 of that amount for the two irrigation treatments. Evaluation of treatment effects on soil quality also began in 2015.

**Acknowledgments:** We thank PREC field crews for assistance in plot establishment and harvesting. The study is supported by grants from the Wyoming Agricultural Experiment Station and Wyoming Department of Agriculture’s Agriculture Producer Research Grant Program.

**Contact:** Jay Norton at jnorton4@uwyo.edu or 307-766-5082.

**Keywords:** conservation tillage, sugarbeet, fertilizer

**PARP:** I, II, VII, IX