BELMONT, KELLI*, W. HOWARD NEIBLING, DON W. MORISHITA, and ERIK J. WENNINGER, University of Idaho, Kimberly Research and Extension Center, 3806N 3600E, Kimberly, Idaho, 83341. **Effects of irrigation, tillage system and fertilizer rate, on sugar beet root and sugar yields.**

Much is not yet clearly understood about the interactive effects of fertilizer application rates, irrigation amounts, and tillage level on the yield and sugar content of sugar beet. Strip tillage and direct seeding in sugar beet became economically viable after glyphosate-resistant technology was introduced. It is known the reducing tillage can reduce operating costs as well as reduce early-season soil water loss by evaporation. Plus, stand loss due to wind can be reduced with more residue from the previous crop available to protect fragile sugar beet seedlings. A field study was conducted in 2013 and 2014 at the University of Idaho Kimberly Research and Extension Center, near Kimberly, ID to determine the effect of irrigation amount, nitrogen fertilizer rate, and level of tillage on weeds in sugar beet. Three tillage levels were established using conventional tillage (CT), strip tillage (ST), and direct seed (DS). Conventional tillage consisted of chisel plowing and disking in the fall followed by disking and final seedbed preparation with a roller harrow in the spring. The strip tillage consisted of fall tilling with an Orthman 4-row strip tillage implement. Direct seed had no tillage operations. Irrigation treatments were based on the sugar beet evapotranspiration (ET) model and were 50, 100, and 150% of ET for conventionally tilled sugar beets. A solid set plot sprinkler system was designed and used for the irrigation treatments. Four nitrogen (N) fertility rates were applied: 60, 80, 100, and 120% of recommended rates for CT sugar beets. Experimental design was a split split block design with tillage as the main plot, irrigation as the sub-plot, and fertilizer rate as the sub-sub-plot.

Average daily soil temperatures did not differ between tillage treatments, however daily maximum and minimum temperatures had greater in CT compared with ST and DS. Soil moisture data suggested that DS was drier deeper in the soil profile, due to the inability of water to penetrate the residue on the soil surface. Analysis of the data showed that root yield in the CT and ST treatments (94 and 92 Mg ha^{-1}) were significantly higher than the DS treatment which averaged 85 Mg ha^{-1}. Although root yield was affected by tillage, estimated recoverable sucrose (ERS) statistically equal among the tillage treatments. The average ERS for tillage type was: CT at 10,902 kg ha^{-1}, ST at 10,564 kg ha^{-1}, and DS at 10,215 kg ha^{-1}. Periodic stand counts at the beginning of the growing season suggest that sugar beet stand was likely the biggest factor affecting DS root and sugar yields in 2013; however, 2014 sugar beet emergence was not influenced by tillage. Irrigation rate did have an effect on ERS yields. The irrigation rates at 100% and 150% ET statistically yielded the same at 10,755 kg ha^{-1} and 11,512 kg ha^{-1}, respectively, which was greater than 50% ET irrigation at 9,413 kg ha^{-1}. Nitrogen rates significantly affected ERS as well with the 100% N rate yielding the lowest compared to 60, 80, and 120% N. Increased N rates such as 100% and 120% N, increased nitrate levels in sugar beet. Despite having increased levels of nitrates in the 120% N treatment, ERS was not affected. There were no significant interactions between tillage, irrigation, and N; suggesting the ET models and N recommendations for CT sugar beet can be used as reference in ST and DS sugar beet systems.