Winter Canola Water Use in Low Rainfall Areas of Eastern Washington and Planting Date Effects

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Introduction

Water remains the most crucial factor driving yields in the low rainfall zones of Washington state. These areas traditionally follow a winter wheat-fallow rotation. Winter canola can introduce diversity into this system. Canola is a relatively new crop in the Pacific Northwest, and its water use patterns aren't clearly understood. Winter canola water use is dependent upon location and climactic conditions and is also effected by planting date. This study aims to quantify canola water use efficiencies and extraction patterns across spatial and temporal landscapes. In the summer of 2013, a planting date study was initiated in Ritzville, WA and monitored for soil moisture content. For the 2014 season, canola water use is being tracked in several variety trial locations.

Experiment and Site Details

2013

- Ritzville, WA
  - silt loam, average annual precipitation 11.8 in
- 4 replicated planting dates of Falstaff
  - June 10, June 26, August 5, and August 12, 2013, and fallow for comparison
- Neutron attenuation to measure volumetric water content incrementally down to 6 feet, every other week

2014

- Okanogan, WA
  - sandy loam, average annual precipitation 11.9 in
- Pomeroy, WA
  - silt loam, average annual precipitation 17 in
- Asotin, WA
  - silt loam, average annual precipitation 15.6 in
- 4 replications of CP115 planted mid-August
- Soil cores taken to 5 feet (or bedrock) for gravimetric analysis
- Biomass samples for weight and N content by LECO combustion

Results Thus Far

Figure 1 shows average cumulative water use for each 2013 Ritzville planting date, plotted across growing degree days. For all dates, it is clear that increased thermal time correlates with more water use. The earlier planting dates accumulated many more growing degree days before winter hit. Within each planting date, water use eventually decreases – soil water content increases – signifying soil profile refilling by precipitation and the end of plant growth. The two June planting dates ceased growth in October, while the August planting dates continued growing well into November.

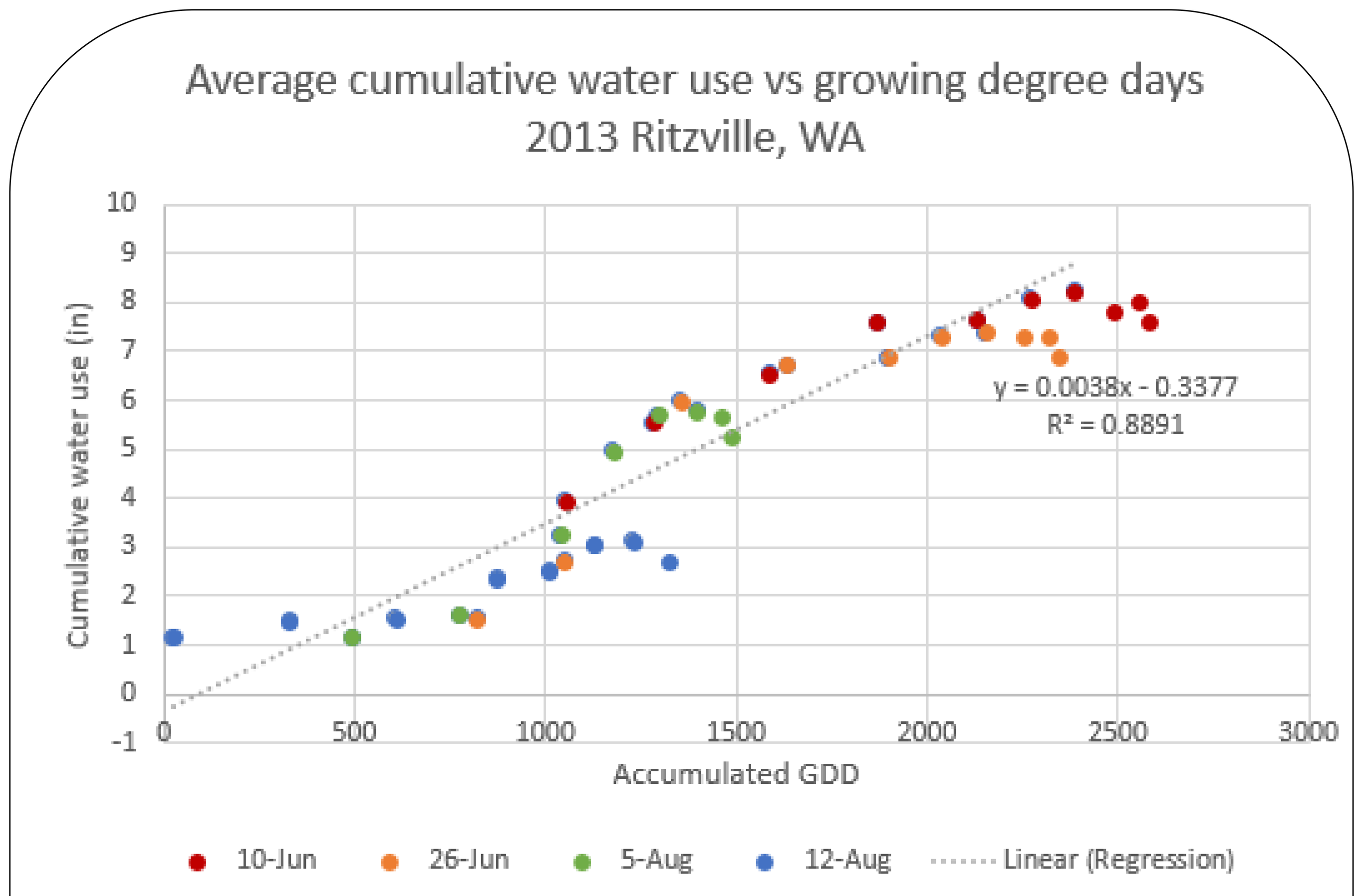

Figure 1. Average cumulative water use over growing degree days. All planting dates are included, delineated by different colors. Water use is defined as precipitation and soil water extraction. Growing degree days were calculated by the summation of average daily temperatures minus the base temperature (0°C for canola).

Figure 2 shows fall 2013 water use – defined as precipitation and soil water extraction – by canola in Ritzville. The earliest planting date of June 10 used over 8in of water, while the canola planted a month later utilized only 3.12in of water, not statistically different from the evaporative loss seen in fallow plots. The progression of water use correlated with winter kill percentages; later-planted canola that used less water had much higher survival rates. The two June plantings had 100% mortality after the harsh winter. It was noted that canola of these earlier plantings had begun to bolt, with average stalk heights over 3in. Indeed, increased crown height also correlated to increased winter kill (data not shown), perhaps due to the loss of snow cover and soil insulation. Moisture measurements were taken in April of 2014, and all planting dates achieved full profile recharge, with values similar to moisture at planting. Due to the excessive mortality, however, the 2013 Ritzville study was terminated.

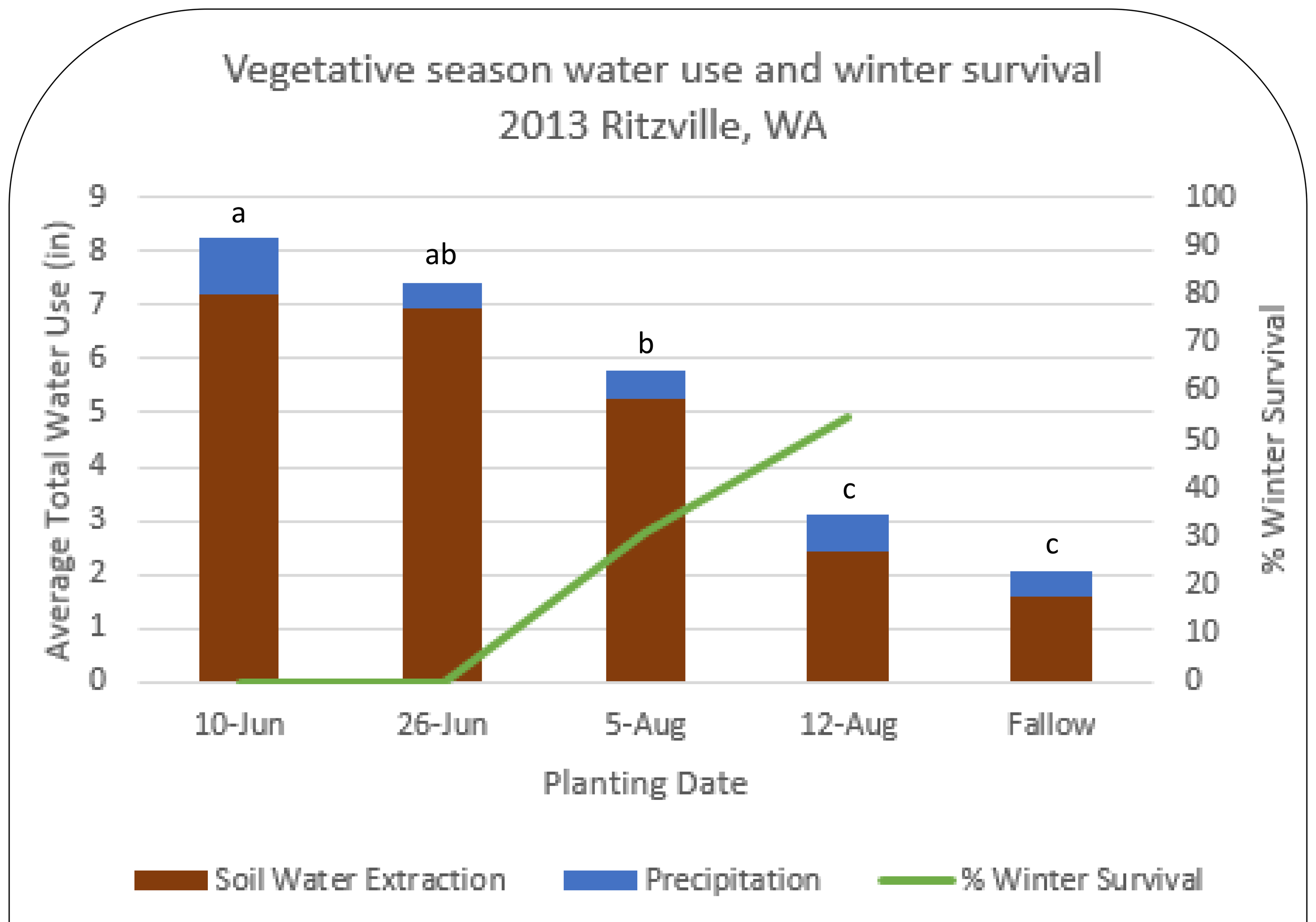

Figure 2. Average total water use in inches for each planting date, from seeding to winter growth cessation, is represented by the bars. Water use is composed of both precipitation (shown in blue) and water extracted from the soil profile (brown). Water use values marked by the same letter indicate no significant difference, as determined by Tukey pairwise comparisons. Average percent of plants surviving winter is depicted as well and corresponds to the right axis.

Soil depth to bedrock in the 2014 Asotin plots was incredibly variable. Water use and content was largely defined by this variable, as seen in figure 3.

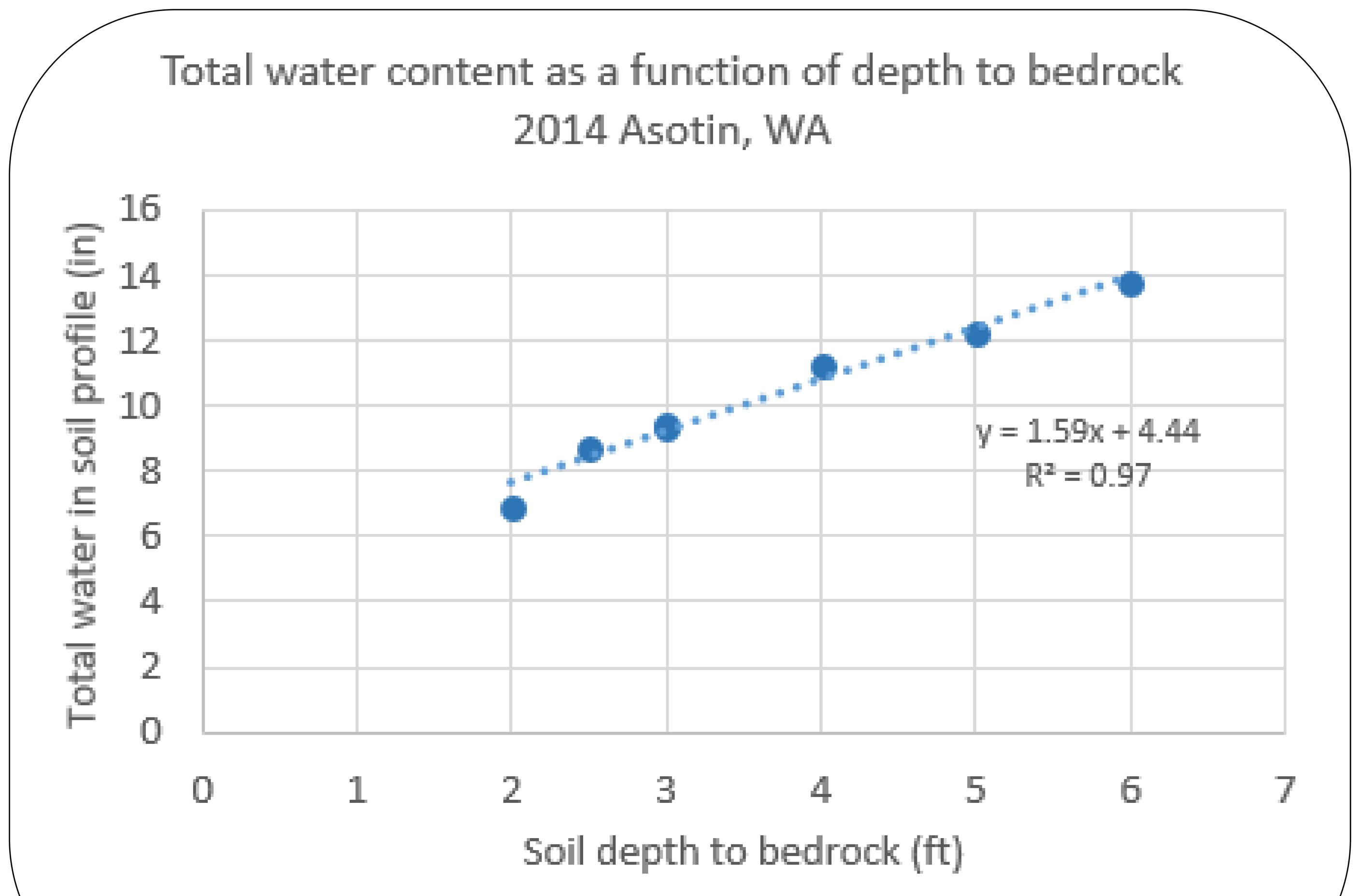

Figure 3. Average total water content vs soil depth on Sept. 6 in the Asotin plots. Cores were taken with a king tube and analyzed gravimetrically.

The volumetric water content (percent water by volume) at several different sampling dates for the 2014 Pomeroy site is shown in figure 4. This pattern of water extraction is common to other locations as well. First the canola uses water in the top few feet of soil. Then water stored deeper in the profile is utilized; canola in Ritzville extracted water below six feet. Canola continues to use deep stored water while precipitation recharges some moisture in the top foot. Eventually, fall growth and water extraction ceases, allowing winter precipitation to fill the entire profile.

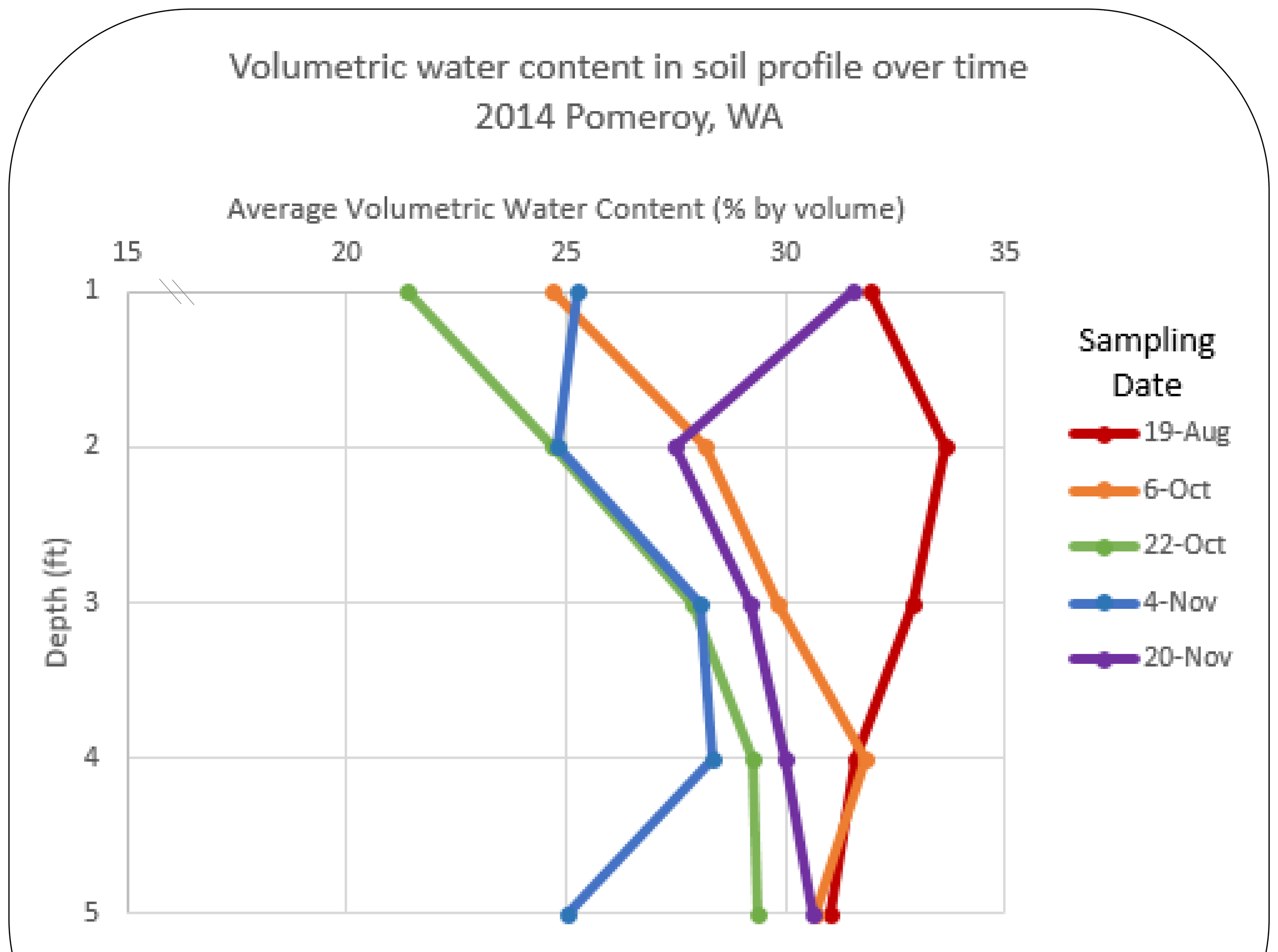

Figure 4. Average volumetric water content throughout a five-foot soil profile as measured at five different times for the 2014 Pomeroy plots. Cores were taken with a king tube and analyzed gravimetrically.

Figure 5 presents the relationship between canola biomass accumulation and water use as seen in two of the 2014 variety trial sites. As evident in this graph, canola in Okanogan used much less water and amassed less dry matter than canola in Pomeroy. Over the entire fall growing season, Okanogan canola used a mere 0.87in compared to the 5.89in of Pomeroy canola. Growing degree comparisons do not explain these water use and biomass discrepancies. Perhaps the growth difference is due to initial soil water content; Pomeroy soil at planting held 19.42in, versus 8.62in in Okanogan. Also, canola in Okanogan did not extract much water below 3ft, suggesting a possible sub-soil obstruction.

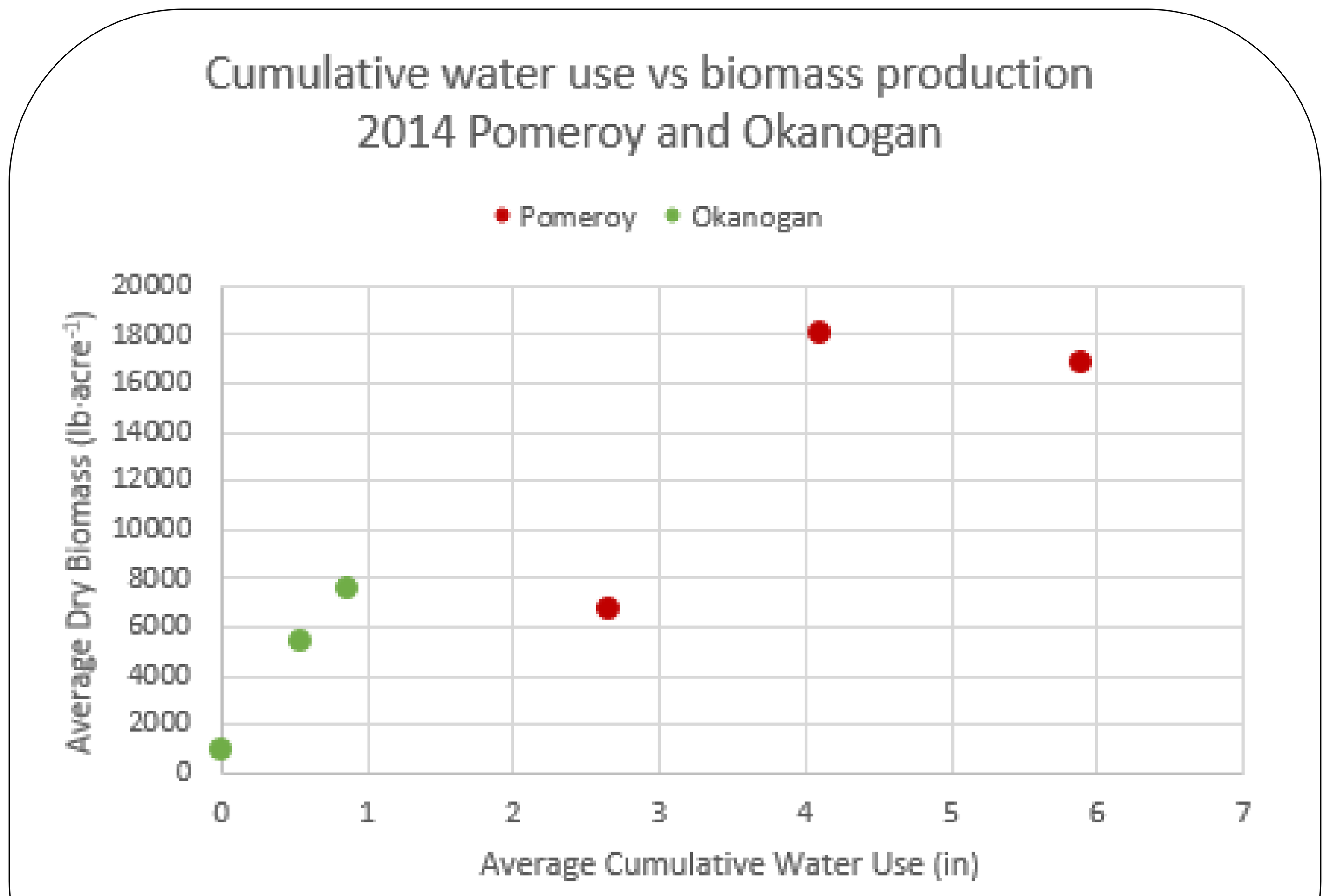

Figure 5. Average biomass dry weight vs cumulative water use for both Pomeroy and Okanogan sites. Soil cores were taken with a king tube and analyzed gravimetrically. Biomass samples were taken in 1m rows and dried in 40°C ovens.

Future Research

Moisture measurements will be continued in spring, and yield characteristics will be determined at harvest. This multiple site water use study will be continued next year, along with a repeated season of the planting date study in Ritzville. Several practical parameters, such as water use efficiencies and nitrogen use efficiencies, will be calculated.