High Residue No-Till for Soil Moisture Retention

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The winter wheat-fallow system comprises 60% of the wheat production area of the Pacific Northwest, and is characterized by winter annual grass weeds, cereal diseases, and soil erosion. Several studies have shown that continuous no-till spring crops were not economically feasible in this low rainfall zone. Winter canola has been evaluated as a viable alternative crop in this region; however, weather dictates when optimum planting time occurs in a traditional tillage summer fallow environment. Current research at the Ralston Project (11 inch rainfall zone) is evaluating the use of tall cereal varieties for maximum biomass production, and harvest with a stripper header to create tall standing stubble, which is maintained during chemical fallow. When compared to cereal crops harvested with a conventional header, the high-residue fallow resulting from stripper header harvest influences the microclimate at the soil surface by reducing soil temperatures and wind speeds, which results in increased seed-zone moisture retention. Maintenance of adequate seed-zone moisture with high surface residues may enable growers to plant winter canola at a convenient late summer planting date, rather than having to rely on early fall rains and/or cool postplant temperatures. More uniform soil moisture in chemical fallow appears to improve canola stand establishment compared to tilled fallow.

Introduction

The low rainfall zone is characterized by average annual precipitation of less than twelve inches, winter annual grass weed infestations, wind erosion, and poor soil quality. Historically, this area has been farmed with a winter wheat-fallow rotation. Previous research at the Ralston site evaluated the viability of spring annual cropping under low rainfall regimes, and found it to be not economically feasible. Research conducted at Ritzville, WA has concluded that annual cropping is not economical under normal conditions (Schillinger et. al., 2007). Because the elimination of the fallow year is not feasible, current research at Ralston is focused on creating and maintaining large amounts of residue during the fallow period by growing tall cereals, harvesting with a stripper header that leaves tall standing stubble, and managing the residues with chemical fallow instead of the traditional tillage.

Winter canola, a rotational crop able to compete economically with wheat, adds diversity and sustainability to the agroecosystem, helps break pest cycles, and improves future winter wheat production. Growing winter canola is more difficult than growing winter wheat. Small canola seed size necessitates a shallower seeding depth than winter wheat, which means that fallow moisture must be nearer to the soil surface for the seed to have adequate water for germination and emergence. The high-residue system created by the tall cereals and harvested with a stripper header appears to positively influence the soil system so that moisture is conserved in the canola seeding zone.

Materials and Methods

Winter wheat ('Farnum') and winter triticale ('099') were planted no-till in chemical or reduced tillage fallow with a JD 9400 drill on 14'' row spacings. Cereals were harvested with either a Shelbourne-Reynolds stripper header or a conventional cutter bar header. In three treatments, weed populations in high residue were managed with herbicides (Image 1) and in the remaining treatment a conservation tillage weed-management approach was used (Image 2). During the fallow period, soil temperatures were recorded hourly, and soil moisture measured gravimetrically every two weeks.

Canola was planted on July 25 and 26, 2013 (Image 3). No-till plots were planted with an AgPro 616 drill on 16'' row spacing and tilled fallow plots were planted with a JD HZ 14 on 28'' row spacing. Data collection in 2014 will include winter survival, soil moisture and temperature, wind velocity, crop biomass, and oilseed yield and quality.

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Results and Discussion

Yields across treatments were similar both years for triticale and in 2012 for winter wheat, regardless of method of harvest (Figure 1). 2013 SW yields were likely lower because of poor soil moisture at planting.

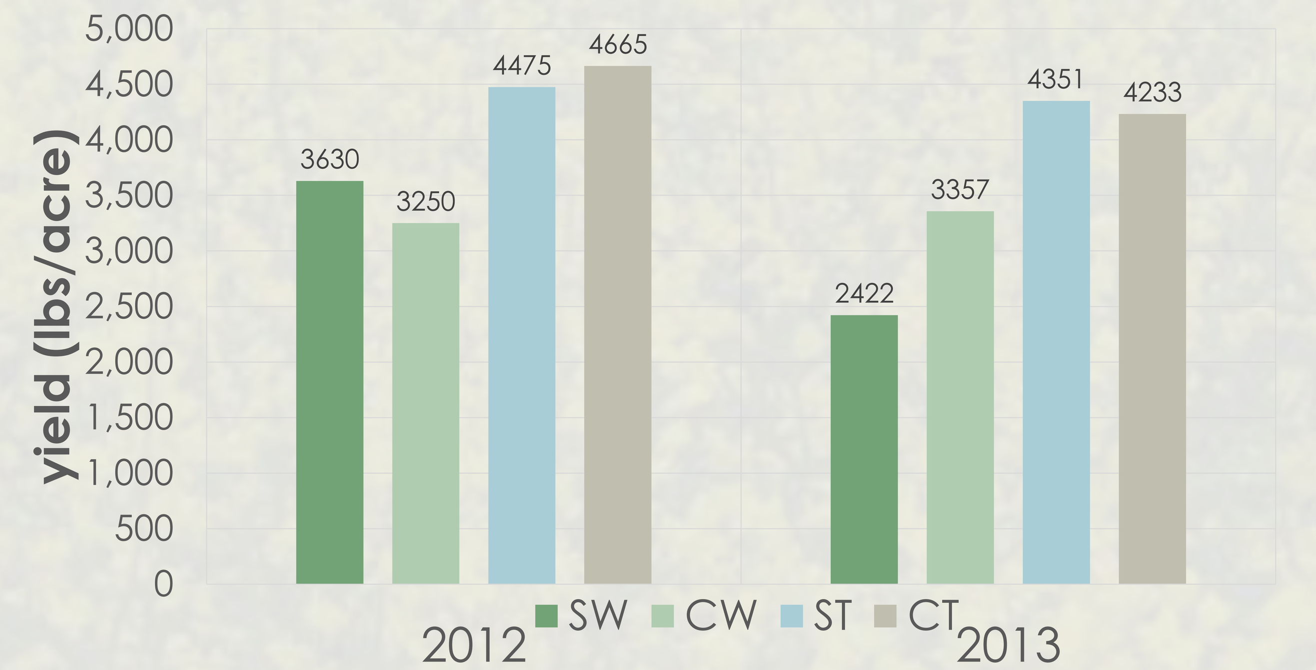

Figure 1: Crop yields by harvest method for stripper headed wheat (SW), cutter bar wheat (CW), stripper headed triticale (ST), and cutter bar triticale (CT).

Compared to semi-dwarf wheat grown previously (1996-2000) at this site, the tall 'Farnum' wheat used in this study (2012 and 2013) produced more residue (Figure 2).

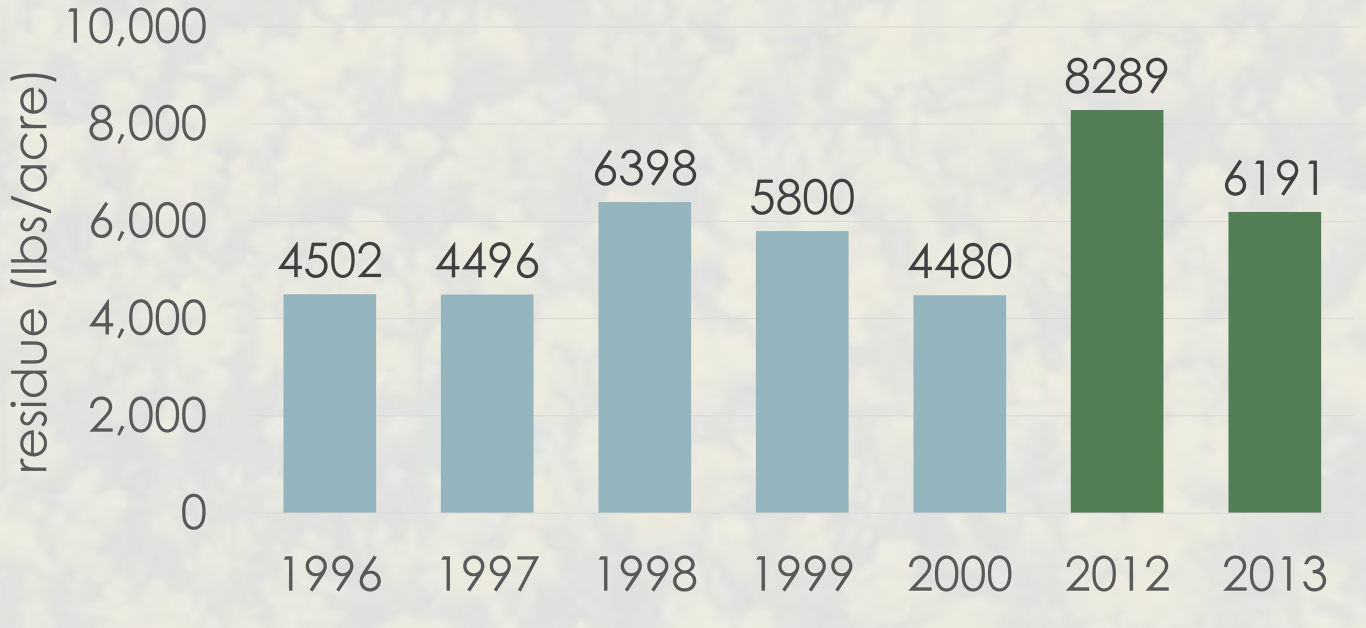

Figure 2: Winter wheat residue production by semidwarf winter wheat varieties on Ralston plots (1996-2000), and with current use of tall wheat.

The height of the stripper header residues (40 inches) led to increased shading and a reduction of soil temperatures when compared to short stubble (18 inches) (Figure 3).

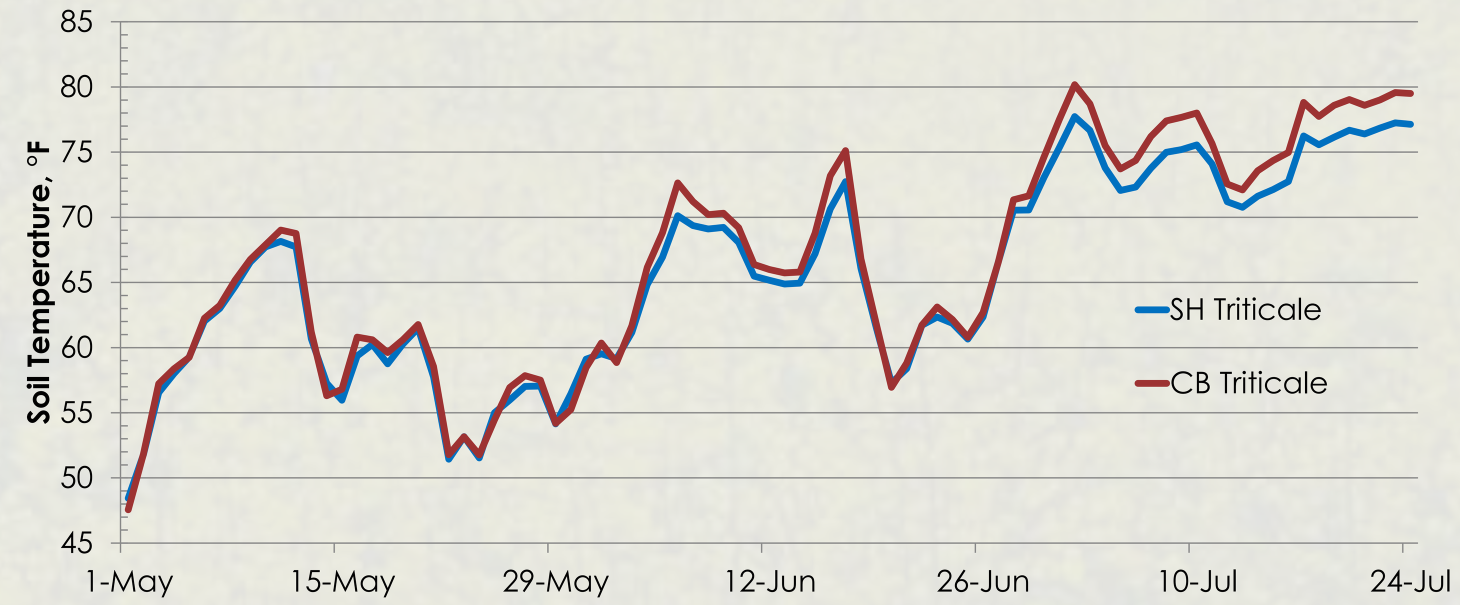

Figure 3: Soil temperatures at ¾ inch depth over the fallow period.

Throughout the season, soil moisture is lower in the cutter bar tilled fallow than in the stripper header chemical fallow. The difference in soil moisture was present at winter canola seeding on July 26 (Figure 4).

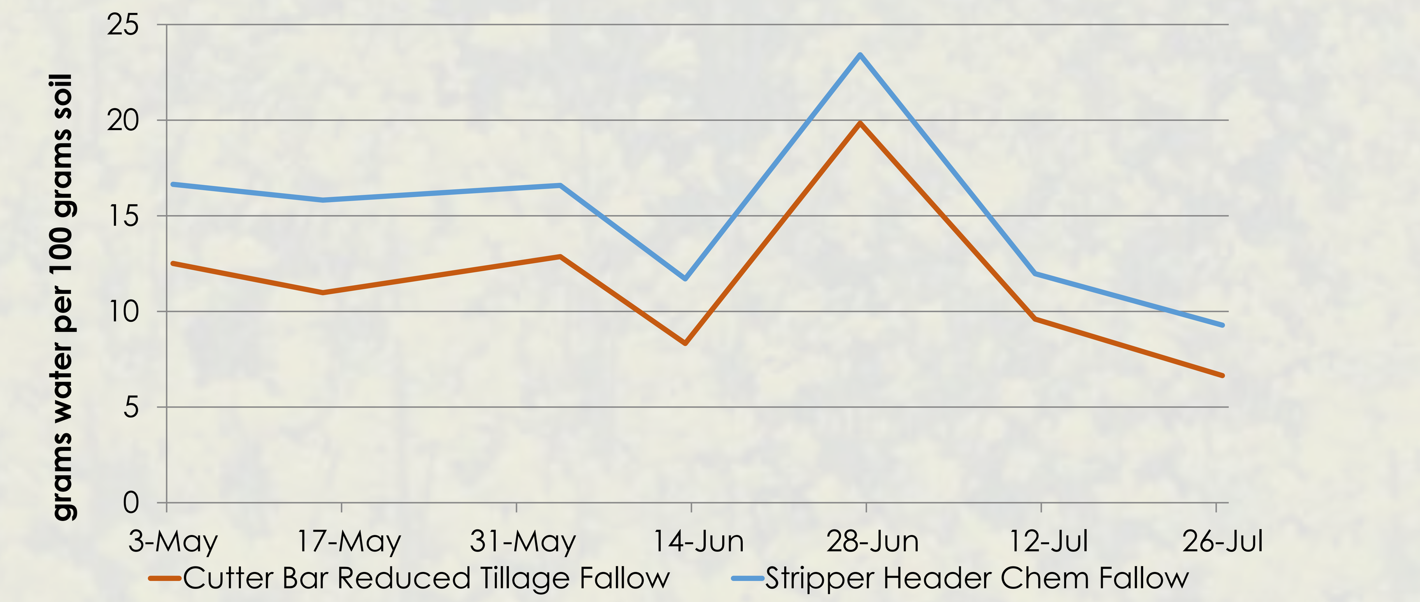

Figure 4: Gravimetric soil moisture in 0-3'' depth of fallow following winter wheat.

Winter canola establishment in reduced tillage fallow (left) was not as uniform as in stripper header chemical fallow (right). This lack of uniformity in establishment may be due to uneven distribution of soil moisture in the tilled plots.

References

Schillinger, W.L., A.C. Kennedy, and D.L. Young. 2007. Eight years of annual no-till cropping in Washington's winter wheat-summer fallow region. Agriculture, Ecosystems and Environment. 120: 345-358.