There have already been several lessons learned from this project, including: (i) an HZ-type drill with 20-inch row spacing and a 150-type drill (i.e., staggered shank openers) with large packer wheels easily passed through heavy, loose residue, (ii) HZ-type drills with 16-inch row spacing and large packer wheels require some type of residue clearance mechanism in front of each boot, such as the offset spider wheel on the McGregor prototype, to avoid plugging, and (iii) there appears to be no advantage of having wide packer wheels (4-inch and 6-inch wide packer wheels halves) compared to narrower versions.

The 2012 experiment site is located on the Eric Maier farm northwest of Ritzville. The site produced 65 bu/acre Bruehl winter wheat in 2011. We cut the wheat in half of the experiment area at 14 inch height and the other at 22 inch height. We will undercut + fertilize at 5.5 inches depth in the spring, just like last year, and rodweed (only as needed to control weeds) at 4 inch depth. Therefore, we expect to have an even more challenging planting situation this year.

Fig. 1. Clockwise from left: (1) the WSU HZ-type drill with adjustable row spacing (seen here at 20-inch spacing); (2) the McGregor HZ-type type drill on 16-inch row spacing with offset spider-wheel row cleaners in front of each opener and; (3) the WSU 150-type staggered-shank hoe-opener drill on 16-inch row spacing. These drills were equipped with 36-inch-diameter packer wheels and all three were successful planting through a deep tillage mulch with heavy residue in the 2011 experiment. Substantial modifications to the WSU drills have been carried out for the 2012 experiment.

Evaporation from High Residue No-till versus Tilled Fallow in a Dry Summer Climate

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Farmers in the low-precipitation (< 12 inch annual) region of the Inland Pacific Northwest practice summer fallow to produce winter wheat in a 2-year rotation. No-till fallow (NTF) is ideal for control of wind erosion but is not widely practiced because of seed-zone soil drying during the summer, whereas adequate seed-zone water for germination and emergence of deep-sown winter wheat can generally be retained with tilled fallow (TF). Successful establishment of winter wheat from late August – early September planting is critical for optimum grain yield potential. A 6-year field study was conducted to determine if accumulations of surface residue under long-term NTF might eventually be enough to substitute for TF in preserving seed-zone water over summer. Averaged over the six years, residue rates of 1300, 5400, and 9400 lbs/acre (1x, 4x, and 7x rates, respectively) on NTF produced incrementally greater seed-zone water but were not capable of retaining as much as TF (Fig. 1). Total root zone (0-to 6-ft) over-summer water loss was greatest in the 1x NTF whereas there were no significant differences in the 4x and 7x NTF versus TF. Average precipitation

storage efficiency ranged from 33% for 1x NTF to 40% for TF. We conclude that for the low-precipitation winter wheat-summer fallow region of the Inland Pacific Northwest: (i) Cumulative water loss during the summer from NTF generally exceeds that of TF; (ii) there is more extensive and deeper over-summer drying of the seed-zone layer with NTF than with TF; (iii) increased quantities of surface residue in NTF slow the rate of evaporative loss from late-summer rains, and (iv) large quantities of surface residue from April through August will marginally enhance total-profile and seed-zone water in NTF, but will not retain adequate seed-zone water for early establishment of winter wheat except sometimes during years of exceptionally high precipitation or when substantial rain occurs in mid-to-late August.

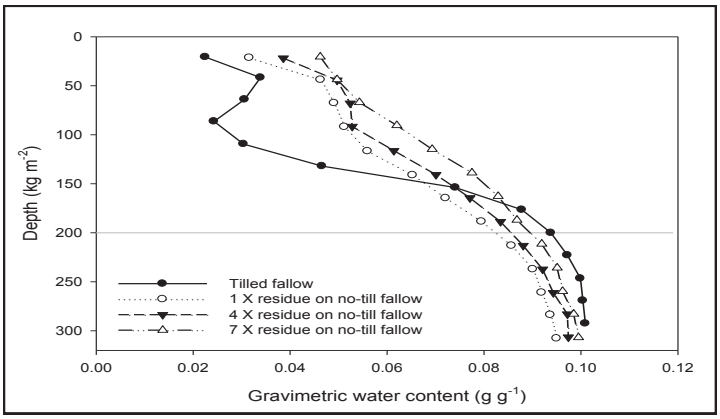

Fig. 1. Average seed-zone water content over the six-year period (each point is the mean of six years and four replications). Treatments are significantly different at 200 kg m^{-2} (which is five inches below the surface, a typical seeding depth). All non-adjacent means at 200 kg m^{-2} (i.e. five inch depth) are significantly different at $P < 0.04$. The year by treatment interaction was not significant.

Predicting Seed-zone Water Content for Summer Fallow in the Horse Heaven Hills

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The Horse Heaven Hills in south-central Washington contains the world's driest rainfed wheat production region. The climate is Mediterranean with average annual precipitation as low as six inches. The cropping system is winter wheat-summer fallow. Tillage is used in the spring of the 13-month fallow to establish a dry soil mulch to help retain seed-zone water to establish winter wheat planted deep into fallow in late August. However, the Horse Heaven Hills is often so dry that even tillage-based summer fallow (TF) cannot retain adequate seed-zone water, and farmers must then wait until the onset of rains in mid October or later for planting. In such dry years, farmers would be better off practicing no-till fallow (NTF) to protect the soil from wind erosion; but no predictive tools are available to assist in these decisions.

The objectives of our study were (1) to predict seed-zone water contents and water potentials in late August or early September based on soil water content measured in early April, and (2) to compare seed-zone water in TF and NTF. Experiments were conducted for five years at each of two sites. Soil water content was measured in both early April and late August. Soil properties and residue loads were characterized to calibrate the Simultaneous Heat and Water model (SHAW). Seed-zone water was simulated in late August based on measured soil water contents made in early April and compared with observed water contents. The SHAW model correctly predicted seed-zone water content 80% of the time. The amount and timing of rainfall occurring in April, May, and June proved to be the most important factor controlling the seed-zone water content in late August, suggesting that farmers should delay their decision on whether to practice TF or NTF until late in the spring.

Fig. 1. Scientists and a research technician measure surface soil bulk density in a no-till fallow plot on the Mike Nichols farm in the western portion of the Horse Heaven Hills.

Our data suggest that farmers should consider delaying their decision on whether to practice TF or NTF until as late as mid June. If at that time, their measured soil water at the 6 to 7-inch depth exceeds 15% by volume, farmers should practice TF and if water content is less than this amount they should practice NTF. There are, however, some practical limitations to our recommendations. Average farm size in the Horse