farm is located in the central HHH on deep Ritzville silt loam soil. Annual precipitation at the Pearson site averages 8.0 inches. The Nichols farm is located in the western HHH on deep Warden silt loam soil and annual precipitation averages 6.0 inches. Both sites are representative of the wind-erosion prone winter wheat–summer fallow Horse Heaven region.

Wheat growers Nichols and Pearson managed all aspects of field operations. The experimental design at both sites was a randomized complete block with four replications. Individual plots were 200 ft long and 60 ft wide. Total plot area at each site is 9.5 acres.

Tillage treatments were:

i) Traditional tillage summer fallow with primary tillage in April with a tandem disk to a depth of five inches followed by a shanking aqua NH_3-N in May and rodweeding only as needed to control Russian thistle and other weeds.
ii) Conservation tillage summer fallow with primary tillage in April with an undercutter sweep + injection of aqua NH_3-N at a depth of five inches, followed by rodweeding only as needed to control weeds.
iii) No-till summer fallow where the stubble from the previous wheat crop is left standing and undisturbed and weeds are controlled with application of glyphosate and other herbicides. Nitrogen fertilizer was delivered at the time of planting with a no-till drill.

We collected numerous data from the two sites, but here we concentrate only on seed-zone water content of summer fallow measured late August and 'Finley' hard red winter wheat grain yield. Seed-zone water content was always lowest in no-till fallow compared to conservation tillage and traditional tillage at both sites all five years (data not shown). At the Pearson site, seed-zone water content in tilled fallow was adequate for late-summer planting in all five years, but replanting was required in 2009 due to crusting rain showers that prevented emergence from the first planting. However, at the drier Nichols site, seed-zone water was adequate for late-summer planting in only one year (2006) out of five. Seed-zone water in no-till fallow was never adequate for late-summer planting at either site.

Wheat grain yield at the Pearson site was significantly higher with conservation tillage and traditional tillage (i.e., early seeding) compared to no-till fallow (i.e., late planting) in four out of five years as well as the five-year average (Fig. 1). Therefore, growers in the central HHH will likely want to continue the practice of conservation tillage summer fallow. However, at the extremely dry Nichols site, where planting of winter wheat was delayed until mid-to-late October in all tillage treatments in all but one year, there was no real grain yield advantage of one system over the other. We do not know why there were considerable within-year grain yield differences among tillage treatments at the Nichols site (Fig. 1) when all plots were planted on the same day, but the bottom line is there was no clear advantage of one system over the other. Since it was not possible to maintain adequate seed-zone water even with tillage-based fallow 80% of the time at the Nichols site, we feel that growers in the western HHH would be better off practicing no-till summer fallow except when over-winter precipitation is exceptionally plentiful (see related article on predicting seed-zone water content by Singh et al. in this booklet). The practice of no-till summer fallow in the western HHH will: i) certainly reduce dust emissions, ii) likely prove economically attractive due to elimination of costly tillage operations, and iii) result in equivalent wheat grain yields compared to tillage-based fallow.

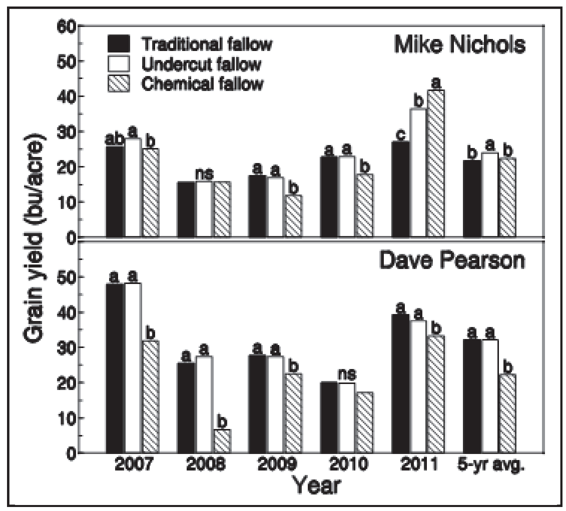

Fig. 1. Hard red winter wheat 'Finley' grain yields with three fallow systems at two sites over five years in the Horse Heaven Hills region of Benton County, WA. Within-year and 5-year average grain yield values followed by a different letter are significantly different at the 5% probability level. ns = no significant difference.

Row Spacing Experiments for Deep-furrow Seeding of Winter Wheat

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Row spacing experiments were conducted at Lind and Ritzville during the 2011 crop year. The purpose of these experiments is to determine if row spacing can be extended beyond the traditional 16 and 18 inches without detrimental effects on winter wheat yield and weed control. Row spacing treatments in the experiment are 16, 18, 20, 22, 24, and 32 inches. All treatments are replicated four times and planted in 100 x 16 ft strips. Xerpha was planted in early September 2010 at both locations.

At Lind, winter wheat grain yields ranged from 29 to 35 bu/acre. There were no significant differences in grain yield, although the 16 and 18 inch spacings, overall, produced more grain than the other spacing treatments (Fig. 1). Grain yields were relatively low because we were unable to apply an air application of fungicide to control stripe rust since the Lind Station contains many wheat breeding nurseries and the breeders do not want fungicide applied to their material.

At Ritzville, winter wheat grain yield ranged from 63 to76 bu/acre (Fig. 1). The 16 and 18 inch spacing treatments produced significantly higher grain yield than the 20, 22, 24, and 32 inch spacing treatments.

Yield component data (data not presented) show that the number of heads per unit area declined with increasing row spacing. Keep in mind that all treatments received the same number of seeds per unit length of row, but not the same number of seeds per acre because the metering flutes on the HZ drill cannot be precisely adjusted. This means that while we planted 50 lbs/acre of seed on the 16-inch row spacing, the planting rate for the 32-inch row spacing treatment was only 25 lbs/acre. We were unable to plant the same number of seeds per acre since the metering flutes of the John Deere HZ drill used in this experiment are not precise enough to calibrate for small planting rate changes. We have addressed this problem by purchasing a special Raven seed metering devise (funded by Ritzville wheat farmer Bill Heinemann) and, beginning in 2012, we will conduct the row spacing experiments with both the same number of seeds per row and the same planting rate (i.e., 50 lbs) per acre in all treatments.

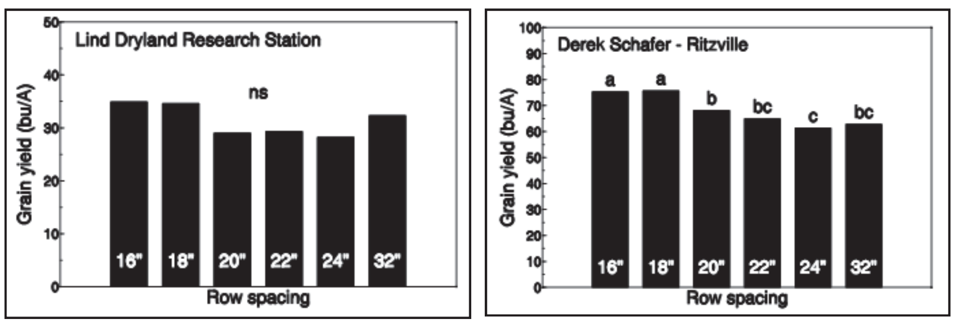

Fig. 1. Winter wheat grain yield at Lind and Ritzville in 2011 as affected by six row spacings. Photo is from harvest of the experiment near Ritzville.

Part 4. Bioenergy Cropping Systems Research

Camelina: Planting Date and Method effects on Stand Establishment and Seed Yield

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There has been keen interest in camelina (*Camelina sativa* L. Crantz) in recent years due to the unique fatty acid composition of the seed oil for human and animal consumption and, more importantly, the value of the seed oil to provide "green energy" to fuel commercial and military aircraft. The objective of our research was to evaluate several planting dates and two planting methods