Soaking Winter Wheat Seed in Water to Enhance Emergence

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Insufficient stand establishment of winter wheat is a major problem in the low-precipitation (< 12 inch annual) dryland summer fallow region of the inland Pacific Northwest. Low seed zone water potential, deep planting depths with 5 inches or more soil covering the seed, and soil crusting caused by rain before seedling emergence frequently impede winter wheat stands. A multiple-year field study was initiated at Lind in early September 2004 to determine seed priming effects on winter wheat emergence and grain yield. Two wheat varieties were used based on their strong (Edwin) and moderate (Eltan) emergence capabilities. The three early phases of germination are: i) imbibition, ii) lag phase, and iii) protrusion of the radicle through the testa. Priming is a procedure that partially hydrates seed to initiate the germination process. The experiment has four treatments: Edwin and Eltan seed both primed and not primed (i.e., check). Primed seed was soaked in water for 12 hours, and then spread on a concrete platform for 15 minutes at 60^0F air temperature under cloudy conditions. Within the subsequent 3-hr time period, seed from all four treatments was then planted into summer fallow with 5 inches of soil cover in 200-ft-long plots with a John Deere HZ deep furrow drill.

After 12 hours of soaking in water, wheat seeds were "glumped" together. But, after just 15 minutes of removal from the water, individual kernels separated easily. Primed seed was soft and kernels were easily destroyed by pinching between fingernails. We were concerned that primed wheat kernels would be damaged when passing through the flutes of the grain drill, but this did not occur. Less than one percent of primed wheat kernels were damaged passing through the grain drill. Primed seed of both varieties emerged significantly better than their checks (Fig. 1). Emergence of Eltan increased dramatically with priming whereas priming had much less effect on Edwin (Fig. 1). In a related study, we found a similar trend between the varieties Edwin and Madsen that were soaked in several priming media (G.S. Giri and W.F. Schillinger, *Crop* Science, 2003). Grain yield and yield components will be measured in July 2005. We plan to continue this experiment for several years.

Tillage Method and Sowing Rate Relations for Dryland Spring Wheat, Barley, and Oat

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No-till (NT) sowing of spring cereals directly into undisturbed stubble of the preceding crop has gained popularity in the inland Pacific Northwest (PNW). But some farmers report lower grain yield of spring cereals with NT compared to sowing after conservation tillage (CT) of the soil. A 4-yr field study was conducted in a 12 inch annual precipitation zone on the Don Wellsandt farm in Adams County, WA to determine sowing rate effects on seed-zone water content, seed-zone temperature, plant stand establishment, grain yield, grain yield components, and straw production for three spring-sown cereal species using both NT and CT. All factors other than tillage method (i.e., drill, fertilizer rate, sowing depth, sowing date) were held constant. Soft white wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), and oat (*Avena sativa* L.) were sown at three rates: 120, 200, and 280 seeds per square yard (roughly 30, 60, and 90 lbs/acre, respectively). A split-plot design was used, with NT and CT as main plots and sowing rate x cereal species combinations as subplots. Residue cover measured just before planting was 87 and 46% for NT and CT, respectively. There were no differences in plant stand between NT and CT, but grain yield was reduced in NT in part due to less water in the seed zone (2-to 6-inch soil depth) compared to CT during early plant development. Likely, disruption of capillary continuity with CT restricted upward movement of water that resulted in greater retention of water in the seed zone underlying the depth of tillage. With NT, soils retained less water in the seed zone but remained wetter near the surface due to greater upward movement and higher residue cover that slowed evaporative loss during the early weeks after sowing. Grain yield was not affected by sowing rate for any crop species because increased number of heads per unit area and kernels per head consistently compensated for reduced plant stand density. Tillage method x crop species and tillage method x sowing rate interactions did not occur for grain yield or any grain yield component. Results show that grain yield of NT across crops was significantly reduced by 90 lbs per acre per year (or 5%) compared to CT.

elevation model (DEM) were incorporated into the model to represent slope, aspect and soil wetness. Major soils found were Spodosols, Andisols, and Inceptisols.

Part 5. Economics and Sustainability

Protein Premiums can Motivate Nitrogen Fertilization of HRSW Beyond Maximum Yield

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The price that a producer receives for hard red spring wheat (HRSW), unlike soft white wheat (SWW), is influenced by protein content (%). The producer receives a price premium on HRSW with greater that 14% grain protein and a discount with less that 14% grain protein. Since both yield and protein percentage directly effect profit, producers may desire to apply levels of Nitrogen (N) fertilizer to HRSW that maximize profits considering both yield and protein. This research extends earlier work to determine weather protein premiums may motivate growers to apply N beyond maximum total yield response, which economists refer to as “stage three” of production.

The objective of this research was to determine economically optimal nitrogen fertilization of HRSW for varying protein pricing structures and to discuss factors which motivate profitable fertilization beyond maximum total product or “stage three” of production. Quality based adjustments in competitive output prices are common in agriculture, but their influence on incentives for profitable production into stage three appears not to have been discussed in previous research. For the southeastern Washington HRSW data used in this study, profit was maximized in stage three whenever the premium/discount for protein relative to the 14% protein base price equaled or exceeded \$0.04/\$0.06 per bushel per 0.25% protein deviations. This premium/discount threshold held for all wheat and nitrogen price combinations examined. At the highest premium/discounts examined, up to 33 lb/ac additional nitrogen beyond maximum yield was applied to capture profitable protein quality premiums. At high premium/discount incentives, the combination of low wheat price and low input price pushed production furthest into stage three, because quality premiums accounted for a greater proportion of total returns. In general, as the proportion of net returns from quality adjustments increases, the incentive to produce into stage three increases.

Economics of No-Till Annual Cropping Systems, Ritzville, WA

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From 1997-2004, William Schillinger conducted a no-till annual spring cropping system experiment in Adams County, near Ritzville, WA. The objective of this study was to determine the long-run economic and agronomic feasibility of no-till cropping systems for low-precipitation areas of the inland Pacific Northwest. The last four years of the study had six rotations involving crops of soft white spring wheat (SWSW), hard white spring wheat (HWSW), spring barley (SB), yellow mustard (YM), and soft white winter wheat (SWWW). The six rotations were: four-year SWWW/SWWW/SWSW/SWSW, four-year SWWW/SB/YM/SWSW, two-year SWSW/SB, two-year HWSW/SB, continuous SWSW, and continuous HWSW. The two-year SWSW/SB rotation and the continuous SWSW rotation were the only two rotations maintained throughout the entire eight-year project period. Conventional tillage soft white winter wheat-summer fallow (SWWW-SF was not included in the experiment. An economic comparison of this traditional system to the experiment’s no-till annual cropping rotations was accomplished by conducting a multi-year yield survey among neighboring SWWW-SF farmers. Comparative yield results for SWWW-fallow on neighboring farms are reported in a separate paper in this section.

None of the rotations were able to generate sufficient market returns to cover total costs during the relatively dry 2001-2004 period. Five of the six rotations earned statistically equivalent returns over total costs. The HWSW/SB,