CROPPING SYSTEMS RESEARCH IN THE DRIEST WHEAT REGION OF THE WORLD

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Summary of Research Findings: For the third year in a row, less than five inches of precipitation occurred during the crop year (1 Aug. 2000 to 31 July 2001) at the Doug Rowell cropping systems site in the Horse Heaven Hills, Washington. Grain yields in 2001 were: continuous annual dark northern spring wheat (DNS), 0.6 bu/acre; recrop soft white winter wheat (SWWW) after spring wheat, 0.5 bu/acre and; SWWW after summer fallow, 2.4 bu/acre. An economic analysis of this experiment by Doug Young et al. in 2001 showed that, between 1997-2000, continuous DNS lagged behind SWWW – summer fallow in profitability by about $40 per acre. Recrop SWWW was more competitive against Russian thistle than continuous DNS, but the severe ongoing drought caused crop failure in all treatments in 2001. This 6-year study will be completed after the 2002 crop year. Growers in the Horse Heaven Hills have advised that, even if annual direct-seeded wheat should become more competitive after many years of direct seeding, they cannot afford the go through the transition period.

Objective: The objective of this long-term experiment is to compare the traditional SWWW – summer fallow rotations with: i) continuous annual direct seeded DNS and; ii) a continuous annual direct seeded SWWW – DNS rotation for wheat grain yield, water use efficiency, control of Russian thistle, and farm economics. The Horse Heaven Hills encompasses approximately 300,000 cultivated dryland acres. This region receives less precipitation than any other non-irrigated cereal production region of the United States, and most likely the world. The long-term average precipitation at the research site on the Doug Rowell farm is only 6.5 inches per year. Low production of crop residue and repeated drought cycles, combined with a tillage during the fallow period, often leaves the soils vulnerable to wind erosion due to lack of residue cover, clods, and roughness.

Materials and Methods: In collaboration with Doug Rowell and the Benton County Wheat Growers Association, a 6-year experiment was initiated in February 1997. The experiment compares the traditional winter wheat – summer fallow rotation to continuous direct-seeded dark northern spring wheat. Beginning in 2000, a continuous direct seed winter wheat-dark northern spring wheat rotation was added. Both the crop and fallow phases of the wheat – fallow rotation are present each year. The experimental design is a randomized complete block with six replications (total of 28 plots). The study covers 8 acres with each plot 300 feet long. Historic winter wheat yields at the site had ranged from 3 to 30 bushels per acre. The Warden silt loam soil (coarse-silty, mixed, mesic Xerollic Camborthids) is more than six feet deep with a slope of less than two percent.

Equipment and field management for the wheat – fallow system are provided by Rowell. Tillage operations entail primary spring tillage in March with a V-shaped sweep implement or tandem disk, followed by 2 or 3 rodweedings as needed during the late spring and summer to control Russian thistle. Fertilizer is not used during dry years. Winter wheat is sown with a deep furrow drill in August if adequate seed-zone moisture is available, or with 10-inch hoe drills after the onset of rains in October or November. In-crop broadleaf weeds are controlled with 2-4,D herbicide.

In the direct-seed treatments, DNS is sown in February or early March with a low-disturbance Cross-slot drill. The Cross-slot is equipped with notched coulters on 8-inch row spacing that deliver seed and liquid fertilizer in one pass. Soil tests for soil moisture and nutrient availability are taken just prior to sowing each year to determine an optimum fertilizer rate based on 3.5 lbs of nitrogen for each expected bushel of wheat production for 14% grain protein. Two or three herbicide applications are required each year for the direct-seed continuous spring wheat system: a pre-plant glyphosate application if downy brome is present, an in-crop broadleaf herbicide, and a post-harvest burn-down herbicide for Russian thistle control. Winter wheat in the SWWW – DNS direct-seed treatment is sown in late October after the onset of fall rains.

Results and Discussion: Only 4.36 inches of 2001 crop-year precipitation occurred and wheat failed in all treatments (Table 1). Only one inch of available water was stored in the soil over the winter. The 5-year average grain yields for winter wheat after fallow is 19.7 bu./acre compared to 8.4 bu./acre for continuous DNS wheat. Recrop winter wheat and spring wheat had essentially died from drought stress before entering the grain fill stage of development.

Ponded water infiltrometer measurements in the early spring of 2001 and 2002 showed no differences in water infiltration rate into the soil between winter wheat stubble (in SWWW – fallow rotation) and continuous direct-seeded DNS wheat stubble. Soil penetrometer resistance was significantly greater in the surface nine inches in plots that had been direct-seeded for the past five years compared to the winter wheat – fallow treatment (data not shown).

An economic analysis by Doug Young et al. (2001) for the Rowell experiment showed that profitability of the continuous DNS wheat system lagged behind the traditional winter wheat fallow rotation by $40/acre per year. Detailed data on soil water dynamics, Russian thistle growth and ecology, and grain yield components (data not shown) have been collected every year from this experiment. Popular and refereed journal articles from this 6-year study will be written following completion of experiment in July 2002.

Table 1. Precipitation, wheat grain yields, and DNS wheat grain protein in the Horse Heaven Hills cropping systems study, 1997-2001.[x]

		Wheat Yield (bushels/acre)			
Year	Aug.–July Precip. (in.)	SWWW after fallow	Cont. SWWW–DNS	Cont. DNS	DNS Protein (%)
1997	9.44	26.5		13.7	10.5
1998	7.87	41.2		18.0	12.4
1999	4.24	8.5		3.8	14.6
2000	4.76	19.8		5.9	14.1
2001	4.36	2.4	0.5	0.6	14.8
5-yr avg.	6.13	19.7		8.4	12.9

[x] Abbreviations: SWWW, soft white winter wheat; DNS, dark northern spring wheat.