Hard Red Winter Wheat Feasibility in Comparison to Soft White Winter Wheat

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Objective:

Producers in the dryland winter wheat-summer fallow cropping region of eastern Washington continue to look for profitable alternatives to soft white winter wheat (SWWW). Hard red winter wheat (HRWW) has a long history in this region but with limited varieties, expensive fertilizer inputs, and grain protein based market prices risk is greater than SWWW production. The objectives of this study are to examine nitrogen fertilizer requirements for profitable HRWW production in comparison to SWWW, and provide a tool that will help minimize producer's risk by determining what price structure is needed to economically produce HRWW as an alternative SWWW in the dryland cropping region.

Study Location:

Location: 5 miles east of Lind, WA.
Annual precipitation: 7-10 inches.
Soil type: Silt loam.
Crop Sequence: summer fallow, winter wheat.

Treatments and Operations:

All winter wheat treatments were seeded on September 4, 2006 and September 10, 2007 with John Deere split packer deep furrow drills at 45 lb/ac. The fallow was previously fertilized in the summer with anhydrous ammonia. The three treatments are as follows:

Treatments	Variety/Class	S. Fallow Applied N	Spring Applied N	Total Applied N
SWWW	'Eltan' SWWW	55 lb/ac	-	55 lb/ac
HRWW	'Bauermeister' HRWW	55 lb/ac	-	55 lb/ac
HRWW-25	'Bauermeister' HRWW	55 lb/ac	25 lb/ac	80 lb/ac

Nitrogen Fertilizer and Soil Tests:

Nitrogen fertilizer management is important for HRWW production to maintain protein levels and minimize the risk of premium discounts, but also because it's often a grower's single largest input cost. Soil tests were collected from each treatment in the spring of the year on February 23, 2007 and March 12, 2008. No significant differences in soil sample were detected between treatments meaning uniform conditions and soil samples could be combined, or averaged, each year (Table 1). The additional fertilizer on the HRWW-25 treatment was applied in the form of Solution 32 on March 19, 2007 and March 14, 2008 with a spoke wheel fertilizer application that placed the fertilizer 4 inches into the soil (Picture 1).

Table 1. Mean soil test results in the spring of the year prior to HRWW-25 spoke-wheel fertilizer application in an on-farm test at Knodel's in 2006-07 and 2007-08.

February 23, 2007				March 12, 2008			
pH		7.0		pH		6.7	
O.M. (1.0%)		**20**	lb N/ac	O.M. (1.4%)		**28**	lb N/ac
P		16	ppm	P		17	ppm
K		388	ppm	K		619	ppm
NH_4		**8**	lb N/ac	NH_4		**9**	lb N/ac
Depth (ft)	NO_3 (lb/ac)	Sulfur (ppm)	Moisture (inches/ft)	Depth (ft)	NO_3 (lb/ac)	Sulfur (ppm)	Moisture (inches/ft)
1	22	4	2.5	1	41	7	2.1
2	50	3	1.7	2	33	5	1.3
3	15	2	2.1	3	10	4	1.3
4	5		1.2	4	10		1.0
5	6		1.1	5	9		1.2
6	7		1.1	6	8		1.9
Total	**104**	9	9.7	Total	**109**	15	8.6
Total Available N in 6'		**132** lb/ac		Total Available N in 6'		**145** lb/ac	

Agronomic Results:

Over the two years, Eltan SWWW produced greater yield than both Bauermeister HRWW without and with 25 lb N/acre additional nitrogen with an average of 51.3-bu/ac compared to only 46.7 and 46.5 bu/ac respectfully (Table 2). HRWW-25 had greater test weight than SWWW at 61.5 lb/bu compared to 60.8 lb/bu and HRWW was not different from either treatment with an average of 61.3 lb/bu. As anticipated HRWW-25 and HRWW treatments had greater grain protein than SWWW at 11.6 and 11.3% protein compared to 10.5% respectfully. No difference in grain protein was detected between HRWW-25 and HRWW.

Calculating post-harvest nitrogen uptake efficiency is one method producers can monitor and refine future nitrogen management practices (Koenig, 2005). Overall SWWW had the highest percent nitrogen uptake efficiency at 56% (Figure 1). HRWW, although less than SWWW, had greater percent nutrient uptake efficiency than HRWW-25 at 47% compared to only 41%. What does this mean? You want winter wheat achieving an N uptake efficiency of 50% or higher. Traditionally if the N uptake efficiency is below this level, such as both HRWW treatments, it could mean N was unavailable to the plant due to denitrification losses, leaching, excessive immobilization by residue, or stranding in dry regions of the soil. In this situation we have differences because of variety selection (yield potential) and over fertilization for the growing conditions. Although post harvest soil sampling was not completed on this research, these lower values may also mean greater amounts of residual N are available for subsequent crop use following HRWW and HRWW-25 and should be considered when making future N applications.

Economic Data:

Gross economic returns were calculated using the Ritzville Warehouse FOB price on September 15 each year and test weight and grain protein premiums and discounts were applied when applicable. Overall, despite differences in yield, test weight, and grain protein, gross economic return between the three treatments were not different with an average of $368/ac (Table 3). Treatment x year interaction was significant, thus the treatments responded different between years. This is mostly because of variations in FOB prices. In 2007, SWWW produced the highest average gross economic return at $411/ac and in 2008 it was significantly with the lowest average gross economic return at only $344/ac. In 2007 SWWW, HRWW, and HRWW-25 had an average FOB price of $8.18, $8.11 and $8.11/bu, and in 2008 the prices were $6.57, $7.45, and$ 7.61/bu respectfully. This represents nearly a 20% drop in SWWW and only 8.1 and 6.2% in HRWW and HRWW-25.

Economic returns above additional fertilizer was calculated by subtracting the gross economic return by the cost of the additional fertilizer applied in the spring only (this was the only cost that varied between the three treatments). In 2007 the fertilizer costs $10.25/ac and in 2008 it costs $15.25/ac. This represents an increase of 48.8%. Overall, despite increased fertilizer costs, economic returns above costs between the three treatments were not different with an average of $363/ac (Table 4). Similar to gross economic returns, treatment x year interaction was also significant, thus the treatments responded differently between years. This is mostly due to the FOB market price and fertilizer costs.

Conclusions:

The first objective of this study was to examine the nitrogen fertilizer requirements for profitable HRWW production in comparison to SWWW. Over two years fertilizer requirements for SWWW and HRWW are similar because of lower yields in HRWW. Table 5 summarizes total available fertilizer, grain yield, lb N/bu, and grain protein. With equal fertilizer applications SWWW averaged 2.7 lb N/bu, and HRWW averaged 3.0 lb N/bu. Within the two HRWW treatments, applying an additional 25 lb N/ac increased lb N/bu to 3.6 but did not increase yield, test weight, or grain protein and overall, no significant economic benefits or detriments were incurred. Perhaps if additional N was applied using another method or in the fall it would have had a larger agronomic impact. Overall, utilizing early spring soil samples to find total available N and dividing that by the each class of wheat's n/bu value (2.7 for SWWW and 3.0 for HRWW) appeared to be a valuable to determine final yield.

The second objective of this study was to provide a tool that will help minimize producer's risk by determining what price structure is needed to economically produce HRWW instead of SWWW in the dryland cropping region. Results show market prices differential between the two classes has a larger influence on the bottom line and can vary dramatically from year-to-year. The economic difference between SWWW and HRWW has to be $27/ac for a 95% percent chance of gaining an economic advantage with either class of wheat. For a producer to have a 95% change of gaining an economic advantage with HRWW it has to have a $1.07/bu advantage (market price +/- premiums/discounts) over SWWW, and if HRWW is selling for $0.10/bu less than SWWW you have a significant economic advantage to produce SWWW (Figure 2). A market price between this range (-0.10 – 1.07/bu) is when growers need to examine available soil test nitrogen, nitrogen price, potential shifts in price between the two classes, available varieties, and other identified risks growers face.

Agronomic Data:

Table 2. Average grain yield, test weight and grain protein over 2 years of SWWW, HRWW and HRWW with an additional 25 lb N/ac applied in an on-farm test and Knodel's farm, Lind.

Treatments	Yield (bu/ac)	Test Wt (lb/bu)	Protein (%)
SWWW	51.3 a	60.8 b	10.9 b
HRWW	46.7 b	61.3 a	11.3 a
HRWW-25	46.5 b	61.5 a	11.6 a
LSD (0.05)	4.0	0.4	0.4
CV	6.7%	0.5%	2.6%

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (P<0.05).

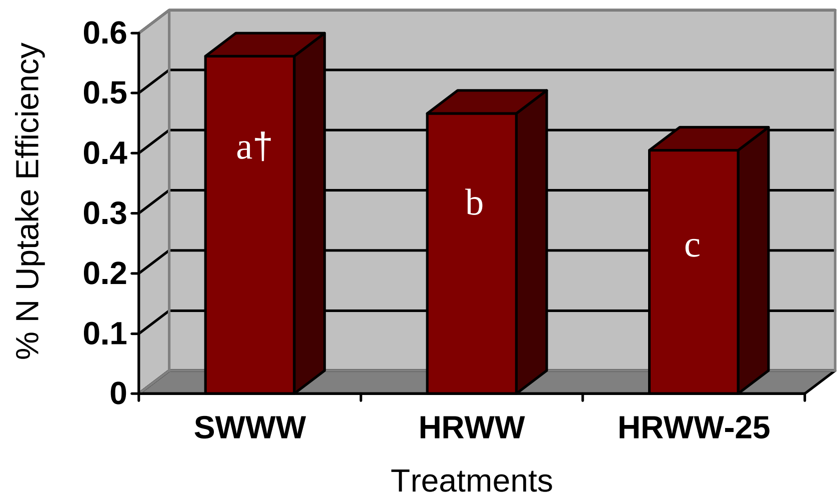

Figure 1. Post harvest nitrogen efficiency expressed as percent nitrogen uptake efficiency of SWWW, HRWW and HRWW with an additional 25 lb N/ac applied in the spring in an on-farm test at Knodel's farm, Lind.

† Treatment means within columns followed by the same letter are not significantly different at the 95% probability level (P<0.05).

Economic Data:

Table 3. Gross economic return and yearly ranking of SWWW, HRWW and HRWW-25 in an on-farm test at Knodel's farm, Lind. Gross economic return was calculated using the FOB on Sept 15, each year at Ritzville Warehouse.

Treatments†	Year† 2006-07		Year† 2007-08		Mean
	$/ac	Rank	$/ac	Rank	$/ac
SWWW	411	1st	344	3rd	377 a‡
HRWW	357	2nd	368	2nd	362 a
HRWW-25	346	3rd	382	1st	364 a
Mean	371 a‡		364 a		368

† Treatment x Year interaction is significant (P<0.01), $LSD_{(0.05)}$ = 39.
‡ Treatment means within columns and rows followed by the same letter are not significantly different at the 95% probability level (P<0.05).

Table 4. Economic return over additional fertilizer costs and yearly ranking of SWWW, HRWW, and HRWW-25 in an on-farm test at Knodel's farm, Lind.

Treatments†	Year† 2006-07		Year† 2007-08		Mean
	$/ac	Rank	$/ac	Rank	$/ac
SWWW	411	1st	344	3rd	377 a‡
HRWW	357	2nd	368	1st	362 a
HRWW-25	336	3rd	367	2nd	351 a
Mean	368 a‡		359 a		363

† Treatment x Year interaction is significant (P<0.05), $LSD_{(0.05)}$ = 39.
‡ Treatment means within columns and rows followed by the same letter are not significantly different at the 95% probability level (P<0.05).

Conclusion:

Table 5. Year, treatment, total spring available nitrogen (soil test + spring applied N), grain yield, actual lb N/bu of grain and grain protein in an on-farm test at Knodel's farm, Lind.

Year	Treatments	Spring Available N (lb/ac)	Yield (bu/ac)	Actual lb N/bu	Protein (%)
2006-07	SWWW	132	50.2	2.6	11.0
2007-08	SWWW	145	52.3	2.8	10.8
Mean		***139***	***51.3***	***2.7***	***10.9***
2006-07	HRWW	132	44.0	3.0	11.8
2007-08	HRWW	145	49.5	2.9	10.9
Mean		***139***	***46.7***	***3.0***	***11.3***
2006-07	HRWW-25	157	42.6	3.7	12.0
2007-08	HRWW-25	170	50.3	3.4	11.3
Mean		***164***	***46.5***	***3.6***	***11.6***

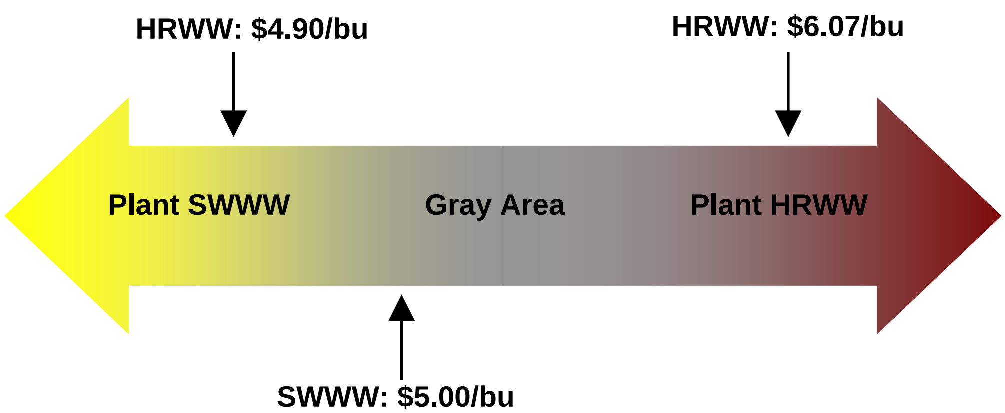

Figure 2. If SWWW is selling at $5.00/bu, HRWW has to be selling for an additional $1.07/bu (market price +/- premium/discount) to have a significant economic advantage over SWWW and selling for $0.10/bu less to have a significant disadvantage. If the price of HRWW is between this range (the "Gray Area") neither class of winter wheat has a significant economic advantage and producers should consider potential shifts in price, soil available nitrogen, nitrogen price, variety selection, etc. to select between classes.

Citations:

Koenig, R.T. 2005. EB 1987. Dryland Winter Wheat, Eastern Washington Nutrient Management Guide. Washington State University Extension. http:pubs.wsu.edu.

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