Oregon State University

Crop Science Report
RESEARCH/EXTENSION

# HARD RED SPRING WHEAT
# PRODUCTION AND MARKETING POTENTIALS AND PROBLEMS

by R.S. Karow [1]

## INTRODUCTION

Hard red spring wheat (HRS) is an alternate class of wheat that can be grown in Oregon. It is an attractive alternative due to its higher dollar value in the marketplace; however, one needs to remember that higher crop value is generally an indication that 1) production costs are higher or that yields are lower than for similar crops, or 2) that some risk is involved in producing the crop. The higher value of HRS over soft white wheat (SWW) can probably be attributed to both factors.

## HOW PRICE IS DETERMINED

The price paid for HRS wheat is based on the protein percentage of the grain. Grain exchange HRS prices quoted in magazines and in newspapers are generally for 14% protein content unless otherwise specified. Grain below 14% is docked, usually 3 to 10 cents for each 1/4% that the grain is below the 14% level. For example, if 14% grain is selling for $4.57 per bushel (April 15, 1985 Portland price) with a 3 cent discount, a grower selling 13% grain would receive only $4.45 per bushel. Additionally, this discount rate generally applies only to a 12 or 13% level. HRS grain below 12% may be severely discounted or may not be marketable at all depending on the overall supply and demand for HRS wheat. Protein is the driving factor behind the higher value of HRS wheat and is the factor which can involve higher production cost, lower yield and greater production risk.

---

[1] Extension Cereals Specialist, Oregon State University, Corvallis, OR 97331.

EXT/CRS 58
6/85

## WHEAT PROTEINS

Protein is directly related to nitrogen. While starches, sugars, fats and protein (the components of a wheat kernel) all contain carbon, hydrogen and oxygen, proteins also contain large amounts of nitrogen (approximately 16% on a 90% DM basis). Carbon, hydrogen and oxygen are provided to plants "free of charge" through the atmosphere and water. Nitrogen must be obtained through fertilizers or through microbial activity in soils or on plant roots (legumes only).

High protein levels in grain require high nitrogen inputs. For example, 6000 lbs. (100 bushels) of 10% protein SWW will contain about 96 lbs.(90% DM basis) of nitrogen. On the other hand, 100 bushels of a 14% protein HRS wheat will contain about 134 lbs. of nitrogen. In addition, sulfur is a common element in proteins. Research suggests that 1/10 to 1/6 lb. of sulfur must be available for each pound of nitrogen to produce proteins. The additional nitrogen and sulfur required for a HRS of equivalent yield to a SWW crop will generally need to be supplied through added fertilizer inputs. Added fertilizer costs can reduce the market price advantage of HRS wheat.

## HRS YIELD POTENTIAL

Another factor to be considered when thinking about HRS wheat production is yield potential. While white and red wheats are of the same species, their genetic backgrounds are quite dissimilar. Some HRS wheats may not have the genetic potential to produce a 120 to 140 bushel crop. HRS wheats have traditionally been bred and grown as dryland wheats in Montana and the Dakotas. The maximum dryland yield in these states rarely exceeds 65 bushels per acre. Successful performance under Plain State conditions does not necessarily equate with successful performance in other production situations. Use of HRS wheat varieties which yield less than the best available SWW varieties again results in a reduction in the price advantage of the HRS grain.

## THE EFFECT OF ENVIRONMENT ON HRS WHEATS

Optimal fertilization and variety selection are not the only factors contributing to successful production of HRS wheat. Environment also plays a major role. Hard red spring crops grown in Montana and the Dakotas generally receive spring rains through the boot or heading stage and are dependent on stored soil moisture for continued growth from heading to maturity. Agronomists in these states feel rainfall during boot to flowering stage contributes more to grain yield than rainfall at any other growth stage. This observation supports detailed studies on water use of winter wheats conducted in Oregon and is in general agreement with current research conducted in other states with both spring and winter wheats.

Adequate moisture is also necessary after flowering to assure proper grain fill. Withholding water after flowering can result in higher protein levels, but this generally occurs because grain is shrunken and has lower test weight. Test weight is a grading factor for HRS wheat and while low test weight is generally not discounted as heavily for HRS as for SWW wheats, low test weights are undesireable.

## OTHER CONSIDERATIONS

There are additional points to consider before planting a HRS wheat crop. These include:

1. Storage. Most country elevators do not have the capacity to handle or store another market class of wheat. Mixtures are always a concern when dealing with several types of grain at a facility originally designed to handle only a single commodity. On-farm storage for HRS wheat crops may be necessary.

2. Marketing. Is there a buyer readily available? How far are you from the nearest delivery point? How will grain be transported to market? If rail cars or barges are part of the transportation chain, will there be added transportation costs due to small volumes? If a poor quality crop is produced, are buyers able and willing to handle such a crop? If so, at what price?

3. Rotations. Will volunteer red grain be a problem in future crops? Will white and red wheat be grown in the same field in consecutive years?

In summary, there are many questions still to be answered about HRS wheat production in Oregon. The crop would seem to have potential in irrigated and higher rainfall areas of the state and has already proven to be a money maker for some growers; however, one must remember that white wheats are not grown in Oregon by chance alone. Experimentation by turn of the century wheat growers indicated that quality soft white crops could most consistently be produced in the state. The many environments of Oregon are generally suited to production of high yielding, low protein wheats. Production of high protein wheat is likely to require a change in traditional management practices and changes in the storage, marketing, and transportation systems for wheat in Oregon.

## PRODUCTION AND MARKETING CONSIDERATIONS

### Production

General production practices for hard red spring wheats are similar to those where soft white springs. There are, however, some special considerations. General production techniques and special needs for hard red spring wheats are discussed below.

1. Field choice - Field choice becomes a matter of concern when producing hard red spring wheat. Soft white and hard red wheats are contrasting classes of wheat in the USDA Grain Grading System. Tolerances are 1% and 2% contrasting (by weight) for US#1 and US#2 Wheat, respectively. A 1% contamination level is about 120 to 125 seeds per pound, though this figure will vary greatly depending on seed size. Contamination is possible if soft whites volunteer in a hard red crop or if hard reds volunteer in a subsequent soft white crop. Contamination can be an even more serious problem if wheat seed crops are being produced. Tolerances for off-type seed are 0, 2/lb., and 5/lb. for Foundation, Registered, and Certified seeds, respectively.

   Herbicide tolerances of hard red spring wheats are generally similar to those of other common wheats. Rotations with chemical fallow and with previous crops treated with glyphosate are possible.

2. Seed bed - Hard red springs can be planted in conventional or conservation-tilled seed beds. In either case, good seed-soil contact will be necessary for uniform germination of seed. Like other wheats, hard red spring wheats do best in soils which are slightly acidic to neutral and have good drainage with no compaction layers.

   When direct-drilling into a previous years white wheat crop, elimination of volunteer grain will be essential. Heavy volunteer stands can lead to seed contamination.

3. Varieties - Variety selection in HRS wheat production is probably more critical than in the production of other grains. Certain varieties tend to be high yielders, but have low protein. Others have high protein but low yield. A few have shown both good yield potential and a good protein level.

   Agronomic characteristics of many of the currently grown HRS wheat varieties are summarized in Table 1. Yield and protein information, where available, is shown in Table 2. In general, the varieties Borah, McKay, and Westbred 906R have shown the greatest promise across the state. Anza is a high yielding wheat that has poor grain quality. Yecora Rojo has shown promise under intensive management in the Klamath Falls area and in northern California, but its performance has not been exceptional in dryland, lower input tests.

   Lodging resistance is another factor to consider when selecting a HRS variety. Since higher nitrogen levels often are needed to optimize protein content, lodging can become a problem unless stiff- strawed, lodging-resistant varieties are used.

Table 1. Agronomic Characteristics For Hard Red Spring Wheats

| | Released | | Agronomic Characteristics | | | | | Disease Reactions[3] | |
|---|---|---|---|---|---|---|---|---|---|
| | Year | State | Head[1] Date | Hgt[2] | Lodg[3] | Test[4] Wgt. | Awns[5] | Stripe Rust | Leaf Rust |
| ANZA | 1971 | CA | M | SD-S | R | 7 | A | R | R |
| BORAH | 1974 | ID | E-M | SD-M | R | 7 | A | R | R |
| FORTUNA[7] | 1966 | ND | E-M | MT | MR | 7 | ALS | R | R |
| MC KAY | 1981 | ID | E-M | SD-M | R | 7 | A | R | R |
| PROFIT 75 | 1975 | WS[6] | E-M | SD-M | R | 7 | A | R | R |
| PROSPUR | 1971 | NK[6] | VE | SD-MT | MR | 7 | A | MR | S |
| SAWTELL | 1977 | ID | M | SD-M | R | 6 | A | MR | MR |
| SHASTA | | CA | E-M | SD-M | | 7 | A | R | MR |
| WS-6 | 1973 | WS[6] | E-M | SD-M | R | 5 | A | - | R |
| WAMPUM | 1978 | WA | E-M | MT | R | 6 | A | R | R |
| WARED | 1974 | WA | L | SD-M | R | 6 | A | MR | -- |
| WB906R | 1980 | WP[6] | E-M | SD-M | R | 7 | A | R | R |
| YECORA ROJO | 1976 | CA | E | SD-VS | R | 6 | A | R | MR |
| YOLO[8] | 1981 | CA | E-M | SD-S | R | 7 | A | R | S |

1 E=early, M=midseason, L=late
2 SD=semi-dwarf, S=short, M=medium, T=tall
3 MR=moderately resistant, R=resistant, MS=moderately susceptible, S=susceptible
4 scale of 1 to 10, 5 being average
5 A=awned, AL=awnletted, ALS=awnless
6 private release, WS=World Seeds, NK=Northrup King, WP=Western Plant Breeders
7 stem rust resistant and sawfly resistant
8 has outyielded Anza and Yecora Rojo in California trials

Table 2. 1983 and 1984 Spring Wheat Yield Data Over Several Sites

| Variety | 1984 Madras | 1983 Powell Butte | 1984 Powell Butte | 1980-4[1] La Grande | 1984 Hillsboro | 1984 Grant Cty, WA | 1983 Kern Cty, CA | 1984 Kern Cty, CA |
|---|---|---|---|---|---|---|---|---|
| | b/a | | | | | | | |
| Anza | — | — | — | — | 50 (10.2)[2] | — | 120 (14.4)[2] | 75 |
| Borah | — | — | — | — | 45 (12.2) | 78 | — | — |
| Dirkwin (SW) | 73 | 66 | 71 | 61 (11.6)[2] | 47 (10.0) | 74 | — | — |
| Owens (SW) | 79 | 73 | 64 | 54 (11.8) | — | 89 | — | — |
| McKay | 74 | 64 | 62 | 61 (13.6) | 46 (10.4) | 90 | — | — |
| Shasta | — | | — | | 41 (11.4) | — | 114 (16.5) | — |
| Twin (SW) | 76 | 72 | 67 | 64 (11.4) | — | — | — | — |
| Wampum | — | 88 | — | 60 (13.3) | — | 93 | — | — |
| Wared | — | — | — | 51 (13.8) | — | 71 | — | — |
| Westbred 906R | 83 | 82 | — | — | 50 (12.0) | — | — | — |
| Yecora Rojo | — | — | — | 35[1] — | 36 (13.2) | 79 | 108 (16.8) | 58 |
| Yolo | — | — | — | — | — | — | 125 (14.3) | 90 |
| lbs/A N | 160 | 135 | 135 | ~100 | 120 | 230 | 200 | 360 |
| Irrigation (inches/acre) | ~20 | ~20 | ~20 | ~12 | 5[3] | NA | 19 | 20 |

1 Yecora Rojo = 1984 only; others 1980, 1981, and 1984.

2 Protein percentage.

3 Rainfall after planting.

4. Seeding Rates and Seeding Depth - HRS wheats generally have smaller seed than soft white wheat. This means that there are more HRS than SW kernels per pound of seed. For example, Stephens soft white winter generally has about 9,000 seeds per pound whereas McKay HRS can have as many as 13,000 seeds per pound. When determining seeding rates, it is necessary to compensate for this difference in seed size.

   At this time, there is no precise plant population that can be generally recommended for all parts of Oregon. In higher rainfall and irrigated areas, 18 to 28 plants per $ft.^2$ (80 to 140 lbs/A) have been used. In dryland areas, 9-14 plants per $ft.^2$ populations (40 to 60 lbs/A) are common though plant densities as high as $20/ft.^2$ have been used. The best recommendation is to use past experience as a guide. Consider the seeding rate used to produce successful crops in the past. If possible, determine an approximate seeds per pound for the variety planted. Determine the number of seeds per pound for the hard red crop to be grown and adjust the poundage seeding rates up or down according to differences in seed size. Many seed suppliers have or are beginning to supply seed size information. This information can be an important tool for making production decisions.

   Another factor to consider in determining seeding rate is the germination percentage of the seed stock. If the germination percentage is below 90%, it may be advantageous to increase the seeding rate to compensate for the lower germination.

   Planting date also influences seeding rate. Higher rates (10-20% more) may be necessary to optimize yield in late plantings as the tillering capacity of plants is reduced.

   A seeding depth of one to two inches is generally adequate. Soil texture and soil moisture play important roles in determining proper seeding depth. Seeding should be deeper in light soils, shallower in heavy soils. In non-irrigated dry soils, seed will need to be placed in moist soil to insure proper germination.

5. Planting Date - In general, to optimize yield protential, plant as soon as possible in the spring; however, do not work wet soil as the resulting compaction is likely to offset any advantage to early seeding. In most areas of the state, early-March to early-April seedings are most successful. Yield potential tends to drop after mid-April.

6. Fertilizer Requirements - As discussed previously, because of the higher protein content of HRS wheats, more nitrogen and sulfur are likely to be needed than for an equivalent SW crop. A soil test prior to fertilization is the best way to determine fertilizer requirements. A test for pH, P,K, and nitrate-N will probably be sufficient for determining HRS production needs.

Cropping history will also affect fertilizer requirements. If a high yielding grass or cereal crop was produced in the previous year and the residue from this crop is to be worked into the soil before planting, additional fertilizer will need to be applied to accomodate breakdown of the residue by microbes. Approximately 10 lbs. of nitrogen is needed for every ton of residue incorporated.

The grain in a 100 bushel, 14% HRS wheat crop contains approximately 134 lbs. of nitrogen. The straw producing this grain will contain an additional 40 to 60 lbs. of nitrogen. As some nitrogen will leach from the soil during the growing season and wheat plants are not able to take up all the nitrogen available in a soil, under optimum production conditions, approximately 225 to 250 lbs. of nitrogen (both soil and applied fertilizer) will be needed to produce a 100 bushel, 14% protein crop.

In general, needed fertilizer can be preplant incorporated, broadcast if rainfall or irrigation will soon follow, or applied in a deep-band if the drill being used has this capability. A small amount of nitrogen as a starter (banded directly with the seed) may be beneficial in early plantings.

A preliminary study on split application of nitrogen conducted in 1984 indicated that there may be some advantage to applying 25 to 50 lbs. of nitrogen after the wheat crop has reached the jointing stage. In this study, any amount of nitrogen applied from jointing to flowering effected grain protein content, and yield in most cases. Fifty pounds of additional nitrogen resulted in protein increases as high as 2%, with an average of about 1%. Work with hard red winter wheats and work in other states generally confirms this response. Wheat plants accumulate most of their dry matter and nitrogen before flowering, hence, nitrogen needs to be available by this stage of growth.

Sulfur is also a protein building block and needs to be readily available to optimize protein in hard red spring wheats. Plant available sulfur leaches readily from light soils and needs to be supplied annually. The optimal nitrogen to sulfur ratio is not known at this time, but a ratio of 10 to 1 is probably sufficient. Coarsely ground elemental sulfur is not a good choice as a sulfur source as it is not readily available to plants and can lead to soil acidification if used excessively over a period of years. Sulfate sulfur or finely ground elemental sulfur are the best sources. If a soil has a naturally high or high residual sulfur level from a previous crop, additional sulfur may not be necessary.

Phosphorus and potassium must also be available to optimize yield potential. Soil test results can be used to determine specific needs for these elements. In early plantings, phosphorus as part of a starter fertilizer is beneficial to achieve rapid growth and good root development.

7. Irrigation - Moisture stress at any growth stage can be detrimental to wheat growth and yield. Wheat water usage is highest during the period from heading to flowering, hence, adequate moisture must be available at this time. Other critical periods are elongation and early grain fill. Insufficient water at elongation tends to result in smaller heads with fewer kernels while water stress at early grain fill can lead to shriveled grain. Surplus water beyond early grain fill can lead to prolonged grain maturation and lower protein levels.

8. Weed Control - As in any cereal production system, adequate weed control is essential to optimize HRS wheat potential. HRS wheats as a group have not shown greater sensitivity to commonly used wheat herbicides than other wheats. Consult your local county agent or pesticide fieldman for information on the proper type, rate, and use of herbicides.

## HARVESTING, STORAGE AND MARKETING SUGGESTIONS

Hard red spring wheats can be harvested with standard grain combines. Be sure the combine, grain trucks, and storage facilities have all been thoroughly cleaned before harvest. Take necessary precautions to avoid white-red wheat mixes. As with all grains, grain moisture at harvest should be below 12% to lessen potential problems with fungi and insects in storage.

If you do not have on farm storage and intend to haul grain directly to a local elevator, contact the elevator operator prior to harvest to be sure delivery will be allowed. During the rush of harvest season, some elevators may not be able to handle truckloads of red wheat.

If using on farm storage, sample grain as it enters the storage facility. Be sure to sample each truckload as wide variations in quality may exist from one part of a field to another. If possible, in different varieties, fields, and or plantings of HRS grains separately until the quality of each lot of grain can be determined. In general, grain lots that are less than 1 to 1 1/2 percentage points different in protein content can be mixed to obtain an intermediate protein level. Mixes of grain differing by more than 1 1/2 to 2 percent often result in a grain with a protein percentage nearer that of the initial low lot than that of the high.

Always have a quality determination made on farm stored hard red spring wheat before you attempt to market the grain. In many instances, on any given day, grain dealers will accept only a specific quality of grain. Before hauling grain to market, it is advantageous to know if the grain will be salable.