# Wheat Variety Screening and Seeding Rate by Variety Trials in the Klamath Basin, 2012

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## Introduction

Grain is produced on upwards of 100,000 acres in the Klamath Basin including nearly 50,000 acres within the Klamath Reclamation Project. Susceptibility to late spring frost has historically limited winter cereal production and spring cereals have accounted for the majority of production. Klamath Basin Research & Extension Center (KBREC) cereal variety evaluation efforts have focused on spring and winter cereal varieties in the past, but with a shortage of seasonal help, funding, and repeated failures due to bird predation, we discontinued winter wheat trials in 2010.

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In 2012, two small grain trials were conducted on-site at KBREC, which has a mineral soil type. These included the OSU Oregon Spring Elite Yield Trial (OSEYT) and the second year of a Wheat Seeding Rate by Variety Trial, measuring the response of different seeding rates on four common wheat varieties. The seeding rate trial was done to evaluate whether common grower practice of seeding spring wheat at rates upwards of 200 lb/ac was justified, updating results from an earlier trial done at a LKL site in 2001 and at both a LKL site and at KBREC in 2002 (Clark and Smith, 2001 and 2002), but testing more commonly grown, newer varieties. Results from the first year of this trial were previously published on the KBREC website (Roseberg and Bentley, 2011).

## Procedures

The KBREC small grain trials were conducted on Poe fine sandy loam soil following potatoes grown in 2011. The OSEYT trial included 35 entries, comprised of 23 named varieties and 12 advanced experimental lines from the Oregon State University and other PNW wheat breeding programs as part of an ongoing, statewide evaluation of potential new variety releases. The variety 'Yecora Rojo' was not part of the official OSEYT list, but was included here (seeded at two different rates 100 lb/ac and 200 lb/ac) due its strong local use, caused by its dependably high protein value. The OSEYT trial was arranged as randomized complete block design with four replications. The Seeding Rate by Variety trial included four commercially available spring wheat varieties (two hard red spring types and two soft white spring types), seeded at four rates (covering the likely range growers typically use in this area). This trial was arranged as a complete factorial with four replications, using the same varieties and seeding rates as in 2011.

For both trials, seed was drilled 0.75 inches deep at with a Kincaid (Kincaid Equipment Mfg.) plot drill. Both trials were seeded on April 24. The plots were 20.0 by 4.5 ft, (9 rows at 6-inch spacing), with a harvested area of 13.5 by 4.5 ft. The OSEYT trial was seeded at 30 seeds/$ft^2$, our norm for these multi-year trials. The Seeding Rate by Variety trial included a range of seeding rates that includes rates growers typically use in this region, which are often higher than those in other PNW wheat-growing regions. Many growers choose seeding rates based on pounds of seed per acre rather than calculating number of seeds per square foot. Thus the seeding rate trial entries were seeded at 100, 125, 150 and 200 lb/ac, but because of size variation among the varieties, the number of seeds/$ft^2$ was not equal among varieties (Table 3).

**Kincaid Plot Drill**

The OSEYT plots were fertilized with 74 lb/ac N, 74 lb/ac $P_2O_5$, 74 lb/ac $K_2O$,and 93 lb/ac S, banded at seeding (applying 12-12-12-15 fertilizer at 618 lb/ac). The Wheat Seeding Rate by Variety Trial plots were fertilized with 74 lb/ac N, 23 lb/ac $P_2O_5$, 46 lb/ac $K_2O$, 98 lb/ac S, and 1 lb/ac B banded at seeding (applying a custom blend of 15.5-4.8-9.7-20.4-0.2B fertilizer at 479 lb/ac). On May 29, both trials were treated with a tank mixture of Rhomene® (MCPA) applied at 0.75 pint/ac (0.35 lb a.i./ac) and Express 75DF® (tribenuron) applied at 0.33 ounce/ac (0.25 ounce a.i./ac) herbicides, using a conventional ground sprayer. An additional 82 lb/ac N and 93 lb/ac S were applied to both trials as 389 lb/ac of granular ammonium sulfate on June 1.

Solid-set sprinklers arranged in a 40-by-40 ft pattern were used for irrigation. Irrigation rates were based on crop water use estimates calculated from the US Dept. of Reclamation Agricultural Meteorological (AgriMet) weather station at KBREC (US Bureau of Reclamation, 2012). Both trial areas received a total of 17.45 inches of irrigation, applied on 17 dates, in addition to 2.08 inches of precipitation during the growing season (from seeding date through harvest date). Plots were harvested using a Hege (Hans-Ulrich Hege) plot combine with a 4.5-ft-wide header. The OSEYT trial was harvested on September 4 and 5. The Wheat Seeding Rate Trial was harvested on September 6.

**Hege Plot Combine**

Grain yield, test weight, lodging percentage, plant height, bird damage, and relative maturity (date of 50 percent heading) were measured at KBREC for both trials. Grain yield is reported on an “as-is” moisture basis after seed cleaning. In this climate grain moisture is almost always approximately 8.0%. Stand counts were measured in the Wheat Seeding Rate trial only. Grain protein was measured for both trials at the OSU Wheat Genetics Lab in Corvallis, OR.

For all trials described here, all measured parameters were analyzed statistically using SAS® for Windows, Release 9.1 (SAS Institute, Inc.) software. Treatment significance was based on the F test at the P=0.05 level. If this analysis indicated significant treatment effects, least significant difference (LSD) values were calculated based on the student’s *t* test at the 5% level.

## Results and Discussion

The spring weather allowed earlier seeding in 2012 compared to 2011 (April 24 compared to May 12). Soil moisture was good during seedbed preparation, and resulting germination and stand density were good. There was good availability of irrigation water during the season. The total of 19.53 inches of irrigation plus precipitation in 2012 was greater than the 13.56 inches applied to the trial in 2011. While there were more hot days in 2012 than 2011 (27 days above 90$^{o}$F in 2012 as opposed to two in 2011, with the highest recorded temperature at 98$^{o}$F), the good moisture resulted in little detrimental effect. Unlike 2011, when there were nine days with minimum temperatures below freezing during the growing season, (all occurred in May or early June), there was only one day (June 7) that just touched freezing in 2012. Overall, yields in 2012 were quite a bit higher than yields of similar trials conducted in the past. It is believed that these excellent wheat yields in 2012 were due to a combination of near-ideal factors: sufficient irrigation moisture, good weed control, overall conducive weather, and an earlier seeding date than in 2011.

*OSU Oregon Spring Elite Yield Trial*

Differences between varieties were statistically significant at the P=0.05 level for all measured parameters (yield, test weight, lodging score, height, 50% heading date, and grain protein content). Yields ranged from 5,766 to 9,947 lb/ac with a mean of 8,387 lb/ac (Table 1). This mean yield is one ton/acre greater than in 2011, which was a reasonably good year in this region. Test weights were greater than the 60 lb/bu industry standard for all but four entries, indicating good moisture, fertility, and weather conditions during the seed-filling phase. The overall mean test weight in 2012 (61.8 lb/bu) was essentially equal to the mean test weight in 2011. Unlike 2011 and some previous years, there was significant lodging for some varieties in 2012. Lodging ranged from zero (21 varieties) to 80%, although only four entries had more than 40 % lodged. Difficulty of harvesting lodged varieties may have factored into their grain yield such that the four varieties with the most lodging also had the lowest four seed yields in the trial. Height ranged from 29 to 46 inches, with a mean of about 39 inches. There was no observed bird damage in the OSEYT trial in 2012.

Multiple-year yield means for all entries that were seeded in the 2010, 2011 and 2012 trials at KBREC were calculated (Table 2). Thirteen entries were seeded all three years, eleven of which were named varieties. For almost every variety that was grown either the last two or three of these years, yields were greater in 2012 than in both 2010 and 2011, often greater by a large amount.

*Wheat Seeding Rate x Variety Trial*

The wheat seeding rate by variety trial included the four most common wheat varieties grown in the Klamath Basin: Alpowa, Bullseye, Yecora Rojo, and Twin. Each variety was seeded at four different seeding rates: 100 lb/ac, 125 lb/ac, 140 lb/ac, and 200 lb/ac. Because seed size is not equal among varieties, the actual seeding rate expressed as number of seeds/ft$^2$ varied between varieties (Table 3). For example, the 200 lb/ac seeding rate varied from 43.8 to 61.6 seeds/ft$^2$ due to this size difference. Due to different seed sources used in each of the two years, the range between the smallest and largest seed was greater in 2012 than in 2011. The differences in plant density and seed yield based on pounds of seed per acre compared to number of seeds per square foot can be seen in Figures 1-4 below, where the seeding rate on the x axis is expressed as either pounds per acre, or as seeds per square ft.

**Seeding Rate Effects:**

Stand counts were taken shortly after germination. The stand counts of all varieties followed seeding rate closely, suggesting approximately equal germination rate for each variety. As would be expected, stand counts generally increased as seeding rate increased (Fig. 1 & 2), with the highest seeding rate resulting in a significantly higher stand count for all varieties (Table 3). However, there was not a consistently higher plant stand count as seeding rate increased in the range between 100 to 140 lb/ac. These results were generally similar to those observed in 2011.

Differences between seeding rates were significant at the P=0.05 level only for plant stand density (as described above) and for lodging (Table 3). Lodging was significantly less at the 100 lb/ac seeing rate compared to higher seeding rates for Alpowa, Bullseye and Twin, but there was minimal lodging for the short-strawed Yecora Rojo at all seeding rates. This was different from observations in 2011, when differences between seeding rates were significant at the P=0.05 level for all parameters measured except for test weight and protein content (Roseberg and Bentley, 2011). Overall, grain yields in 2012 were quite a bit higher than yields of similar trials conducted in the past, similar to results observed for the OSEYT trial described above. It is believed that these excellent wheat yields in 2012 were due to a combination of near-ideal factors: sufficient irrigation moisture (more irrigation was applied in 2012), good weed control, overall conducive weather, and an earlier seeding date than in 2011.

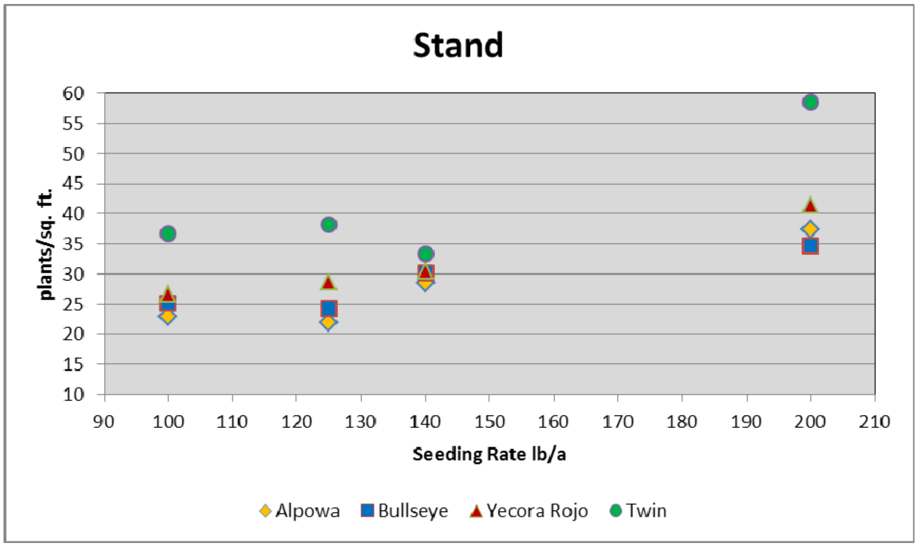


**Fig. 1. Wheat Seeding Rate x Variety Trial Stand Counts (seeding rate expressed as lb/ac)**

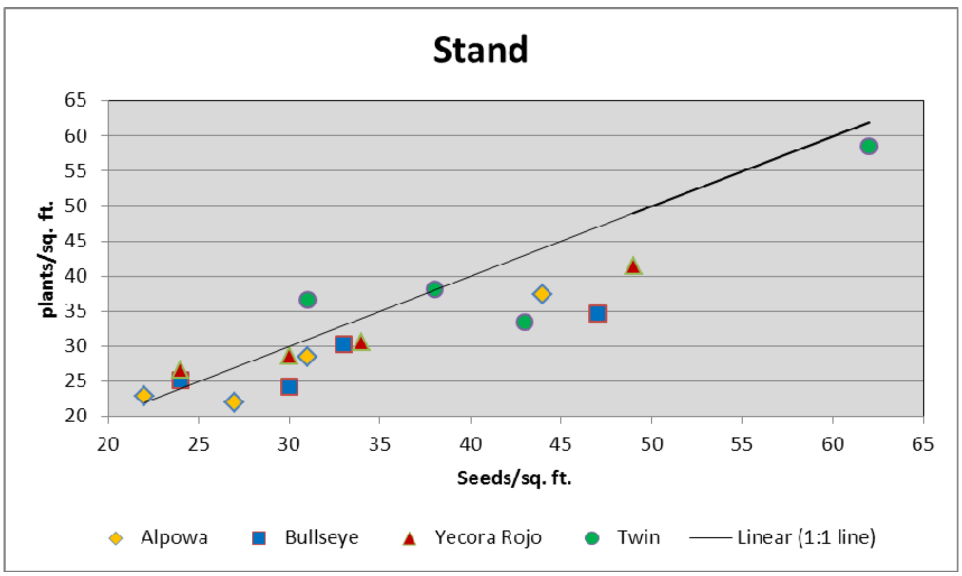


**Fig. 2. Wheat Seeding Rate x Variety Trial Stand Counts (seeding rate expressed as seeds/ft$^2$)**

In the seeding rate trial, yields were almost uniformly excellent for all varieties and seeding rates, and ranged from 8,085 to 9,785 lb/ac, with a mean of 8,936 lb/ac. Thus there was not a significant difference in yield due to seeding rate. If anything, there was a slight trend towards reduced yield as seeding rate increased. This may have been partly due to the detrimental effects of increased lodging as seeding rate increased, although Yecora Rojo (which had very little lodging) also seemed to exhibit this trend. This yield response was unlike the results observed in 2011, when grain yield increased significantly at the higher seeding rates (Roseberg and Bentley, 2011).

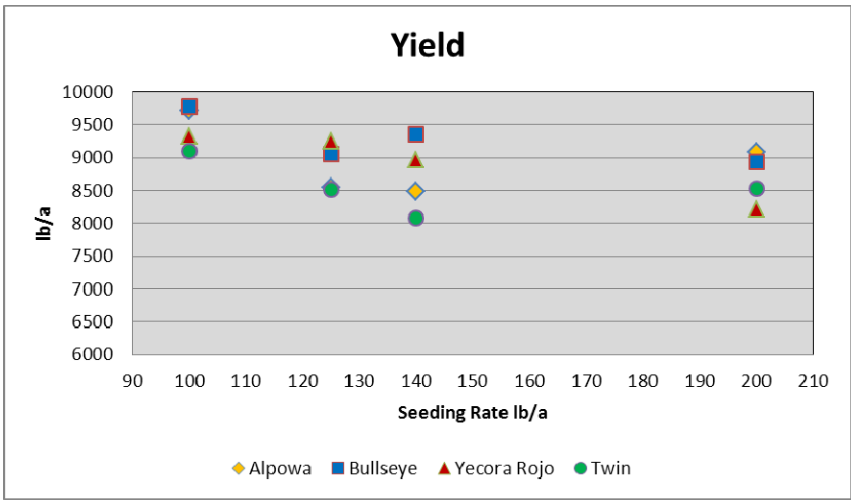


**Fig. 3 Seeding Rate x Variety Trial Yield, 2012 (seeding rate expressed as lb/ac).**

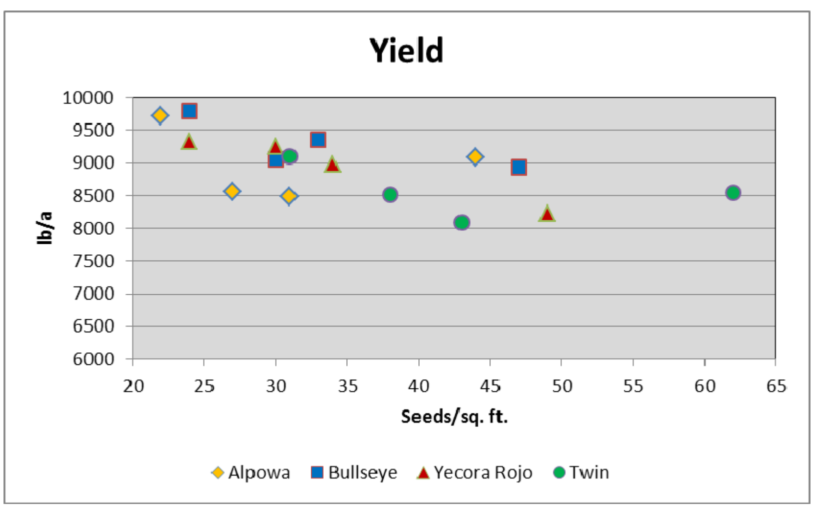


**Fig. 4 Seeding Rate x Variety Trial Yields, 2012 (seeding rate expressed as seeds/ft$^2$)**

**Variety Effects:**

Differences between varieties were statistically significant at the P=0.05 level for all parameters measured except for yield and lodging (Table 3). As mentioned above, yields were almost uniformly excellent for all varieties and seeding rates, and ranged from 8,085 to 9,785 lb/ac, with a mean of 8,936 lb/ac. As was true in 2011, test weights in 2012 were greater than the 60 lb/bu standard for all varieties except Twin, which had test weights between 57.9 and 58.5 lb/bu. Bullseye generally had the highest test weights in 2012 the same as in 2011.

Heights ranged from 29.5 to 43.8 inches, with a mean of 37.4 inches, all of which were somewhat taller in 2012 than in 2011. Alpowa was the tallest variety and Yecora Rojo was the shortest, similar to past results with these varieties. The date of 50% heading ranged from about day 181 to 190, with a mean of day 186, about 10 days earlier in 2012 than in 2011. Yecora Rojo matured earliest, followed by Bullseye, and then Twin and Alpowa, which matured at essentially the same time. Percent protein ranged from 10.6 to 13.1%, with a mean of 11.7%. These values were slightly lower in 2012 than in 2011, which is not too surprising given the much greater yield in 2012. Not surprisingly, the hard red wheat varieties had the highest proteins, especially Yecora Rojo, a variety grown mainly for its consistently high protein content. Based on previous trials at KBREC, these observed differences in measured parameters between varieties were not surprising, even given the consistently excellent grain yields.

## Two-Year Summaries

*OSEYT:*

Growing conditions and management were good in 2011, and the OSEYT had higher yields than we have observed in recent years. In 2012, growing conditions were even better, resulting in excellent yields nearly across the board compared to longer-term averages.

### *Wheat Seeding Rate x Variety Trial*

Results for the Wheat Seeding Rate by Variety Trial were somewhat surprising in both years. When we started this trial, we expected that as seeding rate increased, yield would increase to a certain point, level off, and perhaps even decrease with the highest seeding rates. However, this was not the case in either year. In 2011, grain yields did continue to increase throughout the range studied (up to 200 lb/ac seed), but there was a consistent dip in yield when seeding rate increased from 125 lb/ac to 140 lb/ac. The reason for this ‘yield dip’ was not obvious. This pattern did not occur in 2012, when gain yields were universally excellent at all seeding rates, and thus there was no apparent effect of seeding rate on yield or most other parameters. The high grain yield did correlate to increased lodging at the higher seeding rates.

In the Klamath Basin where high yields are possible under irrigation, but where tillering is limited due to the short growing season, it appears that increasing the wheat seeding rate can increase yield if growing conditions are not ideal, as occurred in 2011. However, if growing conditions are optimal (as in 2012), high yields are possible at all seeding rates studied, and in this case increasing the seeding rate did not result in higher yields.

Crop rotation has some influence on the results of these trials and with grain production in the Klamath Basin in general. In grower's fields, spring grains often follow potatoes grown the previous year, benefiting from typical potato management such as high rates of fertilization and common use of fumigants, which also reduce weed seeds. Even where spring grain follows grain the year before, spring moisture, tillage, and use of grain herbicides often results in good stands with low weed pressure levels, but monoculture of continuous wheat or barley may be more susceptible to buildup of certain weeds and other pests. It is thought that the winter flooding commonly practiced in the Klamath Basin may ameliorate some of the disadvantages of a continuous small grain crop rotation.

## Acknowledgements

The OSEYT trial was conducted in cooperation with, and partially supported by, the OSU Wheat Genetics Program (Dr. Robert Zemetra and Dr. Mike Flowers) via funding provided by the Oregon Wheat Commission.

Special thanks to Mark Larson of the OSU Wheat Genetics Research Group who conducted the grain protein analysis for the seeding rate trial.

## References

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**Table 1. 2012 OSU Oregon Spring Elite Yield Trial (OSEYT), seeded in mineral soil (ranked by yield). Klamath Basin Research & Extension Center, Klamath Falls, OR.**

| Entry | Type[1] | Yield (lb/ac) | Test Wt (lb/bu) | Lodge (%) | Height (inch) | 50% Heading (day of year) | Protein (%) |
|---|---|---|---|---|---|---|---|
| WB 1035 CL+ | SWS | 9947 | 62.6 | 0 | 41 | 185 | 12.4 |
| Bullseye | HRS | 9885 | 64.5 | 6 | 36 | 186 | 13.2 |
| Yecora Rojo 2X[2] | HRS | 9878 | 64.0 | 0 | 31 | 184 | 13.2 |
| IDO 687 | SWS | 9845 | 63.7 | 0 | 40 | 187 | 11.4 |
| IDO 644 | SWS | 9581 | 60.6 | 23 | 40 | 185 | 11.4 |
| IDO 599 | SWS | 9524 | 60.6 | 25 | 40 | 185 | 11.5 |
| Summit 515 | HRS | 9352 | 61.7 | 0 | 33 | 186 | 13.7 |
| IDO 686 | SWS | 9335 | 63.0 | 9 | 46 | 188 | 11.6 |
| IDO 671 | SWS | 9156 | 62.2 | 10 | 41 | 189 | 11.4 |
| Yecora Rojo 1X[2] | HRS | 8991 | 62.9 | 0 | 31 | 184 | 12.7 |
| Alturas | SWS | 8969 | 61.7 | 1 | 41 | 188 | 10.9 |
| Redwing | HRS | 8855 | 60.7 | 0 | 30 | 188 | 14.0 |
| WB-Fuzion | HRS | 8820 | 62.7 | 0 | 43 | 185 | 13.9 |
| Lassik | HRS | 8584 | 61.3 | 0 | 34 | 187 | 12.7 |
| WB-Hartline | HWS | 8579 | 58.7 | 26 | 39 | 187 | 14.3 |
| Patwin 515 | HWS | 8550 | 60.5 | 0 | 30 | 189 | 12.8 |
| C-2821 | HRS | 8495 | 59.7 | 0 | 43 | 188 | 12.7 |
| Alpowa | SWS | 8483 | 61.7 | 13 | 45 | 193 | 11.9 |
| Cabernet | HRS | 8378 | 63.6 | 0 | 34 | 186 | 13.1 |
| Whit | SWS | 8349 | 62.3 | 24 | 41 | 187 | 11.3 |
| Cal Rojo | HRS | 8300 | 61.5 | 0 | 29 | 186 | 12.9 |
| Volt | HRS | 8270 | 63.5 | 0 | 40 | 192 | 13.2 |
| Babe | SWS | 8258 | 63.1 | 15 | 44 | 188 | 11.1 |
| 97S621 - 05 | HRS | 8229 | 64.5 | 0 | 43 | 189 | 14.1 |
| UC 1618 | HRS | 8206 | 61.6 | 0 | 35 | 189 | 12.7 |
| Clearwhite 515 | HWS | 8187 | 61.7 | 0 | 37 | 183 | 14.1 |
| WB-Rockland | HRS | 8110 | 62.5 | 0 | 32 | 191 | 15.2 |
| IDO 694 | HWS | 8109 | 62.4 | 0 | 33 | 182 | 13.6 |
| Jefferson | HRS | 8018 | 61.4 | 34 | 41 | 186 | 13.5 |
| Kelse | HRS | 7839 | 62.9 | 0 | 40 | 188 | 14.8 |
| 90314 | HRS | 7579 | 59.6 | 0 | 30 | 187 | 13.3 |
| Buck Pronto | HRS | 7481 | 62.4 | 18 | 41 | 185 | 14.5 |
| BZ-401 | HRS | 7420 | 62.9 | 0 | 45 | 180 | 14.5 |
| Glee | HRS | 7410 | 60.8 | 54 | 41 | 186 | 13.6 |
| Louise | SWS | 7005 | 60.5 | 71 | 42 | 188 | 11.7 |
| Diva | SWS | 6262 | 59.4 | 80 | 42 | 189 | 11.9 |
| JD | CLB | 5766 | 61.4 | 80 | 46 | 191 | 13.0 |
| Mean | | 8387 | 61.8 | 14 | 38.7 | 187.0 | 12.9 |
| ***P* value** | | **<0.001** | **<0.001** | **<0.001** | **<0.001** | **<0.001** | |
| LSD (0.05) | | 1490 | 1.7 | 24.9 | 2.3 | 1.8 | 0.8 |
| CV (%) | | 12.7 | 1.9 | 129.3 | 4.2 | 0.7 | 4.5 |

[1]HRS = hard red spring; HWS = hard white spring; SWS = soft white spring; CLB = club.

Grain yields shaded in gray are not significantly different from the highest yield in this trial.

[2] Yecora Rojo plots were replicated, but not randomized, and thus their data is not included in ANOVA calculations.

[2] Yecora Rojo 1X was seeded at 93 lb/ac and Yecora Rojo 2X was seeded at 186 lb/ac.

**Table 2. 2010, 2011 & 2012 Three-year yield summary, OSU Oregon Spring Elite Yield Trial (OSEYT) seeded in mineral soil (ranked by 2-yr mean yield). Klamath Basin Research & Extension Center, Klamath Falls, OR.**

| | | Yield (lb/ac) | | | 2-yr mean | | 3-yr mean | |
|---|---|---|---|---|---|---|---|---|
| Entry | Type[1] | 2010 | 2011 | 2012 | Yield (lb/ac) | Rank | Yield (lb/ac) | Rank |
| IDO671 | SWS | 7860 | 8364 | 9156 | 8760 | 1 | 8460 | 1 |
| IDO687 | SWS | | 7343 | 9845 | 8594 | 2 | - | - |
| IDO686 | SWS | | 7376 | 9335 | 8356 | 3 | - | - |
| Alturas | SWS | 7190 | 7740 | 8969 | 8355 | 4 | 7966 | 3 |
| IDO644 | SWS | 7680 | 6762 | 9581 | 8171 | 5 | 8008 | 2 |
| Alpowa | SWS | 5650 | 7847 | 8483 | 8165 | 6 | 7327 | 5 |
| IDO599 | SWS | | 6707 | 9524 | 8116 | 7 | - | - |
| Bullseye | HRS | 6710 | 6158 | 9885 | 8022 | 8 | 7584 | 4 |
| Babe | SWS | 5160 | 7244 | 8258 | 7751 | 9 | 6887 | 7 |
| Whit | SWS | 6510 | 6389 | 8349 | 7369 | 10 | 7083 | 6 |
| Lassik | HRS | 6120 | 5781 | 8584 | 7183 | 11 | 6828 | 8 |
| Yecora Rojo | HRS | | 5314 | 8991 | 7153 | 12 | - | - |
| UC1618 | HRS | | 6023 | 8206 | 7115 | 13 | - | - |
| Kelse | HRS | 6040 | 6285 | 7839 | 7062 | 14 | 6721 | 10 |
| Jefferson | HRS | 6220 | 6051 | 8018 | 7035 | 15 | 6763 | 9 |
| Glee | HRS | | 6632 | 7410 | 7021 | 16 | - | - |
| Cabernet | HRS | 5970 | 5471 | 8378 | 6925 | 17 | 6606 | 11 |
| Buck Pronto | HRS | | 6352 | 7481 | 6917 | 18 | - | - |
| Louise | SWS | | 6519 | 7005 | 6762 | 19 | - | - |
| Diva | SWS | 6180 | 7096 | 6262 | 6679 | 20 | 6513 | 12 |
| JD | Club | 4860 | 6578 | 5766 | 6172 | 21 | 5735 | 13 |
| **Mean** | | **6319** | **6668** | **8349** | **7509** | | **7114** | |

[1]HRS = hard red spring; HWS = hard white spring; SWS = soft white spring.

**Table 3. 2012 Response of four spring wheat varieties to seeding rate.**
**Klamath Basin Research & Extension Center, Klamath Falls, OR.**

| Variety | Type[1] | Seeding Rate (lb/ac) | Seeding Rate (seeds/ft$^2$) | Yield (lb/ac) | Test Wt (lb/bu) | Height (inch) | 50% Heading (Day of Year) | Stand (plant/ft$^2$) | Protein (%) | Lodging (%) | Yield Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alpowa | SWS | 100 | 21.9 | 9718 | 62.9 | 43.8 | 189.8 | 22.9 | 11.3 | 1.3 | 2 |
| | | 125 | 27.4 | 8551 | 62.1 | 43.3 | 190.3 | 21.9 | 11.4 | 20.0 | 11 |
| | | 140 | 30.7 | 8483 | 62.5 | 43.8 | 189.5 | 28.5 | 11.5 | 18.8 | 14 |
| | | 200 | 43.8 | 9082 | 62.3 | 43.3 | 189.8 | 37.4 | 12.0 | 42.5 | 7 |
| Bullseye | HRS | 100 | 23.7 | 9785 | 64.3 | 35.5 | 184.5 | 25.1 | 12.1 | 0.0 | 1 |
| | | 125 | 29.6 | 9053 | 63.7 | 33.8 | 184.8 | 24.2 | 11.7 | 0.0 | 8 |
| | | 140 | 33.1 | 9356 | 64.2 | 33.8 | 183.5 | 30.2 | 12.1 | 12.5 | 3 |
| | | 200 | 47.3 | 8937 | 63.9 | 36.0 | 184.3 | 34.6 | 11.9 | 46.3 | 10 |
| Yecora Rojo | HRS | 100 | 24.3 | 9329 | 63.9 | 30.3 | 182.8 | 26.6 | 12.9 | 0.0 | 4 |
| | | 125 | 30.4 | 9249 | 63.4 | 29.5 | 182.8 | 28.6 | 12.4 | 3.8 | 5 |
| | | 140 | 34.0 | 8972 | 63.3 | 32.0 | 182.8 | 30.5 | 13.1 | 6.3 | 9 |
| | | 200 | 48.6 | 8223 | 63.5 | 30.8 | 180.8 | 41.5 | 11.4 | 0.0 | 15 |
| Twin | SWS | 100 | 30.8 | 9097 | 58.5 | 41.0 | 189.0 | 36.6 | 10.6 | 0.0 | 6 |
| | (awnless) | 125 | 38.5 | 8517 | 57.9 | 40.3 | 189.0 | 38.2 | 11.3 | 27.5 | 13 |
| | | 140 | 43.1 | 8085 | 58.1 | 42.0 | 189.5 | 33.4 | 11.5 | 30.0 | 16 |
| | | 200 | 61.6 | 8537 | 58.1 | 39.8 | 188.8 | 58.5 | 10.8 | 27.5 | 12 |
| Mean | | | | 8936 | 62.0 | 37.4 | 186.3 | 32.4 | 11.7 | 14.8 | |
| ***P* (Variety)** | | | | **0.302** | **<0.001** | **<0.001** | **<0.001** | **<0.001** | **<0.001** | **0.084** | |
| ***P* (Seeding Rate)** | | | | **0.135** | **0.199** | **0.145** | **0.106** | **<0.001** | **0.437** | **0.009** | |
| ***P* (Variety X Seeding Rate Interaction)** | | | | **0.920** | **1.000** | **0.182** | **0.180** | **0.648** | **0.337** | **0.401** | |
| LSD (0.05) | | | | NSD | 0.6 | 1.1 | 0.7 | 6.2 | 0.7 | 16.1 | |
| CV (%) | | | | 11.8 | 1.4 | 4.0 | 0.5 | 26.7 | 7.8 | 153.5 | |

[1]HRS = hard red spring; SWS = soft white spring.