Forage and Grain Yield Potential of Non-Irrigated Spring Grains in the Klamath Basin, 2010

Richard J. Roseberg and Rachel A. Bentley[1]

Introduction

Concerns were raised about loss of soil from wind erosion with the announcement in early 2010 that most Klamath Reclamation Project water users would receive a delayed and reduced rate of irrigation water during the 2010 growing season, with some areas potentially receiving no irrigation water for the entire season. Fields that had grown grain, hay, or other similar crops in 2009 had adequate cover from vegetative residues to prevent wind erosion damage. The main wind erosion concern was for fields that had grown potatoes or onions during the 2009 growing season or that were tilled in the fall of 2009 in preparation for 2010 row crops and thus had little or no vegetative cover. A secondary concern was the potential for weeds to proliferate where non-irrigated fields were not managed with some type of crop cover. In 2001 a more severe irrigation reduction occurred and both wind erosion and weed proliferation were significant problems in some areas that year.

[1] Associate Professor and Faculty Research Assistant, respectively, Klamath Basin Research & Extension Center, Klamath Falls, OR.

In the Klamath Basin, annual cereal forages produce one cutting and typically result in a high biomass yield of hay suitable for feeding many types of livestock. Cereal hay prices are generally lower than those of higher quality hay such as alfalfa, perennial grass, and grass/alfalfa mixtures, but may prove to be useful in a drought situation. Cereal crops are commonly seeded following potatoes and are harvested for either grain or forage, thus utilizing some of the nutrients that may remain in the soil from the potato crop.

In 2010, a completely non-irrigated spring cereal grain and forage trial was conducted at KBREC. The goal of this trial was to find an effective cover crop, requiring minimal inputs, which could minimize soil erosion and discourage weed growth in fields where irrigation water is not available, while still producing a harvestable crop. Some entries repeated results from a smaller and simpler non-irrigated spring grain trial conducted at KBREC in 2001 (Clark and Smith, 2002).

Procedures

The dryland cereal grain and forage trial was seeded at KBREC on a Poe fine sandy loam soil following potatoes grown in 2009. All plots for a given seeding date were seeded in a single large block, thus seeding dates were not randomized or replicated across the field, and results of the two seeding dates were evaluated with separate analysis of variance. Within each seeding date block, each of the four fertilizer/herbicide treatment combinations was replicated three times. The grain varieties were randomized and replicated three times within each seeding date block. Individual plots were sized and arranged to allow both forage and grain harvest within different sections of a given plot. Seeds were drilled at 1.5 inch depth at a rate of 60 lb/ac with a Kincaid (Kincaid Equipment Mfg.) plot drill on March 19 and April 16. The plots were 30.0 by 4.5 ft, (9 rows at 6-inch spacing).

The four combinations of fertilizer and herbicide ('treatments') used in the grain trial were as follows: treatment A: no fertilizer, no herbicide; treatment B: no fertilizer, with herbicide; treatment C: with fertilizer, with herbicide; and treatment D: with fertilizer, no herbicide. To avoid confounding forage yield and quality results with weed contamination that occurred where no herbicide was applied, the forage trial results included treatments B and C only (where herbicide was applied).

The plots that received a fertilizer treatment received 55 lb/ac N, 16 lb/ac P_2O_5, and 60 lb/ac S (applying a custom-blended 19.7-5.6-0-21.5 fertilizer at 280 lb/ac), broadcast on April 28 for the first seeding date, and May 3 for the second seeding date. The plots that received herbicide were treated with a mixture of Rhomene® (MCPA) applied at 0.75 pint/ac (0.35 lb a.i. /ac) and Banvel® (dicamba) applied at 0.19 pint/ac (0.1 lb a.i. /ac) herbicides, using a conventional ground sprayer, on May 25. There was no additional fertilizer or herbicide applied during the growing season.

The 12 grain varieties were as follows: Alpowa spring wheat, 102 winter triticale, Merlin awnless spring triticale, common cereal rye, Baronesse spring barley, Twin awnless spring wheat, Strider facultative barley, Stephens winter wheat, Cayuse spring oats, Charisma spring oats, Stockford awnless spring barley, and Metcalfe spring malting barley.

Kincaid Plot Drill

No irrigation water was applied at any time during the growing season. During the growing season, the areas harvested for grain yield received 3.62 inches of precipitation for the first seeding date, while the second seeding date received 2.57 inches of precipitation. The areas harvested for forage received between 3.24 and 3.39 inches of precipitation during the growing season for the first seeding date (depending on maturity and harvest date of individual varieties), while the second seeding date received between 2.19 and 2.34 inches.

The grain harvest trial was harvested at the end of the season when all grain was mature. In the forage harvest trial, plots were cut once during the growing season (Fig.1).

Grain was harvested using a Hege (Hans-Ulrich Hege) plot combine with a 4.5-ft-wide header on September 13 and 14. Forage was harvested with a tractor-mounted Carter (Carter Mfg. Co. Inc.) flail harvester with a 3.0 ft-wide header. Forage cutting dates were chosen based on overall physiological maturity of the 12 varieties individually. Thus, within each seeding date block, all three reps of a given variety were cut when seedheads were in the soft dough stage. Using this criterion, the forage harvest dates for the first seeding date were as follows: Alpowa, Merlin, and Common Rye on June 30; Twin on July 7; Cayuse and Stephens on July 13; Charisma and Strider on July 21; and 102 triticale, Baronesse, Metcalfe, and Stockford on July 30. For the second seeding date the forage harvest dates were as follows: Alpowa, Merlin, and Common Rye on July 7; Twin on July 13; Cayuse on July 21; Baronesse, Charisma, Metcalfe, and Stockford on July 30; and 102 triticale, Stephens, and Strider on August 13 (although 102 triticale and Stephens, because they are true winter types, did not vernalize and thus did not have heads at the time of harvest).

For the grain plots, grain yield, test weight, and a weed rating (taken on June 28) were measured. The weed rating was a visual estimation of the proportion of weeds compared to crop plants within a plot. Thus, a rating of 0 indicates no weeds, only crop plants visible, and a rating of 100 indicates all weeds and no crop plants visible. The calculated 'good seed' value indicates the proportion of good, clean seed compared to the total amount of harvested material (including chaff, weed seed, and other non-crop material as collected through the combine) before any post-harvest cleaning. A 'good seed' value of 100 means that there was no chaff, weed seed, or other material present in the combined seed. Thus this number gives an indication of how 'clean' the crop seed was immediately after combining. For the barley varieties, the 'percent plumps' (percent of cleaned seed larger than the 6/64 sieve) was also measured.

For forage plots, forage fresh weights were measured immediately in the field and samples were collected from each plot for drying to correct yields to a dry weight basis as well as perform forage quality analysis. After drying and weighing, samples were ground to 2-mm-sieve size in a Wiley Mill (Arthur H. Thomas Co.) and to 1-mm-sieve size in an Udy Mill (UDY Corporation) before being analyzed in a near infrared spectrophotometer (NIRS) (NIRSystems, FOSS, NA, Minneapolis, MN) to determine forage quality. Quality testing at KBREC was accomplished using the NIRS and equations developed by the NIRS Consortium, Madison, WI (NIRS Consortium, 2007) applicable for small grain forage. Reported forage quality parameters included crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), relative feed value (RFV), and relative forage quality (RFQ).

For each seeding date, the trial was analyzed as a split plot design, with the herbicide/fertilizer treatment as the main plot and the grain variety as the sub-plot. All measured parameters, for both the grain trial and the forage trial, 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

Soil moisture was good during seedbed preparation, and resulting germination and stand density were fairly good, especially for the first seeding date. Timely spring rains encouraged early season growth. However, a few days of high winds may have damaged some of the emerging grain from sand blasting, especially for the second seeding date. The resulting final stand was relatively poor compared to the irrigated grain trials grown nearby at KBREC in 2010, even allowing for the lower seeding rate in this non-irrigated trial.

Grain Harvest Trial

<u>First Seeding Date:</u>

Differences in yield between fertilizer/herbicide treatments were not statistically significant, but differences in yield were statistically significant between varieties at the

P=0.05 level (Table 1). Neither of the two oat varieties produced a harvestable grain yield for any of the four treatment combinations due to excessive weed competition and/or low crop stand count. Poor weed control also resulted in non-harvestable grain yield for Metcalfe and Stockford barley where herbicide was not applied. The true winter triticale type (102 triticale) did not vernalize and thus remained vegetative and did not produce any viable seedheads. Stephens winter wheat must have received enough short-day chilling conditions to vernalize, as it did produce a harvestable grain yield for the first seeding date. For treatment combinations that had a harvestable grain yield, yields ranged from 100 to 5,381 lb/ac with a mean of 1,150 lb/ac. Common rye was clearly the most vigorous type and produced the highest yield by far in the first seeding date, while Stockford awnless barley was the lowest.

As with first seeding date yields, differences in test weights (lb/bu) were statistically significant between varieties only. Test weights for wheat varieties were greater than the 60 lb/bu industry standard only for Alpowa, and then only where herbicide was applied. Test weights for the barley varieties were higher than the 48 lb/bu industry standard for only Metcalfe and one of the fertilized treatments of Baronesse. There is no official industry standard for triticale test weight, however 52 lb/bu is generally considered good. All triticale test weights were below this number. All four common rye treatments had test weights higher than the industry standard of 56 lb/bu. Overall, test weights were lower than the relevant industry standard in most cases, indicating inadequate moisture, fertility, loss of crop vigor due to weed competition, or related factors during the seed-filling phase. However, the common rye had a very good combination of grain yield and test weight, indicating it was well-suited for these conditions.

Differences in weed ratings were statistically significant for both the fertilizer/herbicide treatment and variety. The weed rating ranged from 0 to 90.0%, with a mean of 19.4%. Not surprisingly, the treatments that received herbicide (B and C) had the lowest weed ratings for almost every variety, while the treatments that did not receive any herbicide (A and D) had the highest weed ratings. The common rye had essentially no weeds, even where herbicide was not applied, due to its vigorous growth and high stand density. Cayuse oats had the highest weed rating of all varieties for all fertilizer/herbicide treatments.

Differences in percent good seed were statistically significant for both fertilizer/herbicide treatment and variety. Percent good seed ranged from 58.2 to 96.6%, with an average of 87.3%. Not surprisingly, treatments B and C (receiving herbicide) had the highest percent good seed. Common rye had the highest average percent good seed among all harvested varieties for all treatments. Adding fertilizer did not improve percent good seed where herbicide was not applied, in most cases. However, Baronesse barley with no fertilizer and no herbicide had the lowest percent good seed (58.2%) of any variety/treatment combination. For the barley varieties, the differences in percent of seed retained on the 6/64 screen (the plumpest seed) were not statistically different for fertilizer/herbicide treatment or variety.

Second Seeding Date:

For the second seeding date, differences in yield between fertilizer/herbicide treatments were not significant, but differences between varieties were statistically significant (Table 2). As with the first seeding date, the two oat varieties were not harvested due to excessive weed competition and poor stand, and Stockford barley's yield was again low due to low stand and significant weed competition. As was true for the first seeding date, 102 triticale did not vernalize and thus did not produce a harvestable seed yield. However, the yield results were different for Stephens winter wheat and Strider facultative barley than they were for the first seeding date. From the later seeding date, neither produced a harvestable number of seedheads, indicating that they did not vernalize sufficiently from the later seeding date, and remained vegetative, despite low weed pressure. Overall, grain yield ranged from 61 to 5,027 lb/ac for plots that were harvested, with a mean of 888 lb/ac. Overall, grain yields were lower for the second seeding date than for the earlier seeding date. As was true for the first seeding date, common rye had the highest yields for the second seeding date, while Stockford awnless barley was again the lowest among varieties that had a harvestable yield.

Differences in test weights (lb/bu) for the second seeding date were statistically significant between fertilizer/herbicide treatments and varieties, while the interaction was not significant. Test weights tended to be highest for the treatments that received herbicide (treatments B and C). Comparing response to fertilizer, test weights tended to be slightly higher where fertilizer was not applied for treatments that did not receive herbicide (treatment A vs. D) and for those that did receive herbicide (treatment B vs. C). Test weights were lower than industry standards for all varieties except Alpowa and common rye, which were only slightly above industry standards.

Weed ratings were statistically significant for both fertilizer/herbicide treatment and variety. The weed rating ranged from 0 to 45.0%, with a mean of 9.1%. As in the first seeding date, the treatments that received herbicide (B and C) had the lowest weed ratings. Again, the common rye had essentially no weeds, even where herbicide was not applied, due to its vigorous growth and high stand density, while the Stockford awnless barley had the highest.

Percent good seed was statistically significant for both fertilizer/herbicide treatment and variety. Percent good seed ranged from 29.1 to 95.8%, with an average of 82.5%. As with the first seeding date, the treatments that received the herbicide application had the highest percent good seed. Common rye had the highest average percent good seed among all harvested varieties, and Stockford awnless barley had the lowest. In some cases the addition of fertilizer without herbicide (treatment D compared to A) dramatically decreased the percent good seed, even where weed ratings were similar (Baronesse, Merlin, Stockford, and Twin).

As true of the barley varieties in the first seeding date, the differences in percent of seed retained on the 6/64 screen (the plumpest seed) were not statistically different for fertilizer/herbicide treatment or variety for the second seeding date. Barley plumpness percentages ranged from 78.8 to 90.2%, with a mean of 82.0%. For both seeding dates, the observed barley plumpness was less than we typically see in irrigated trials having good weed control.

Forage Harvest Trial

First Seeding Date:

For the first seeding date, differences in yield between fertilizer/herbicide treatments were not statistically significant, but differences between varieties were significant at the P=0.05 level (Table 3). Yields ranged from 1,491 to 9,395 lb/ac with a mean of 3,755 lb/ac. As was true of the grain trial, common rye was the highest yielding variety in the first seeding date, while Cayuse oats was the lowest.

As with forage yield results, differences in CP between fertilizer/herbicide treatments were not significant, but differences between varieties were significant. CP ranged from 9.3 to 14.6, with a mean of 11.5. The variety with the highest CP was 102 triticale; common rye was lowest. The addition of fertilizer (treatment C) did not consistently increase CP. Measured differences between ADF were only significant for variety. ADF ranged from 28.7 to 38.4, with a mean of 32.5. Common rye had the highest ADF, and Stephens wheat had the lowest. Differences in NDF were statistically significant for both fertilizer/herbicide treatment and variety. NDF ranged from 44.2 to 58.3, with a mean of 50.0. Common rye had the highest NDF, and Cayuse oats had the lowest. In most cases the addition of fertilizer increased NDF.

Differences in RFV were statistically significant for both fertilizer/herbicide treatment and variety. RFV ranged from 94 to 134, with a mean of 119. Cayuse oats was the variety with the highest RFV, with common rye was the variety with the lowest. Somewhat mirroring the ADF and NDF results, RFV was generally higher where fertilizer was not applied. Measured differences between RFQ were only significant for variety. RFQ ranged from 85 to 130, with a mean of 115. The variety with the highest average RFQ was Twin awnless wheat, while common rye was the lowest.

The difference in the way RFV and RFQ are calculated may explain some of the reason why the calculated statistical significances, as well as responses of individual varieties and treatments, may not be the same for RFV and RFQ. Whereas RFV is a relatively simple calculation derived from ADF and NDF, RFQ is a more complicated calculation derived from non-fibrous carbohydrate, crude protein, fatty acids, nitrogen-free NDF, 48-hour *in vitro* digestibility, and NDF (Undersander and Moore, 2002). Thus, the RFQ calculation attempts to estimate animal intake more accurately than RFV by including additional important nutritive qualities in the equation.

Second Seeding Date:

For the second seeding date, differences between the fertilizer/herbicide treatments were not significant for any of the measured parameters at the P=0.05 level (Table 4). On the other hand, differences between varieties were significant for all of the measured parameters. Yields ranged from 1,401 to 7,423 lb/ac with a mean of 3,704 lb/ac. As was true for the first seeding date, common rye had the highest yield for the second seeding date.

CP ranged from 9.5 to 16.2, with a mean of 12.3. As in the first seeding date, 102 triticale had the highest CP values. Twin wheat had the lowest CP values. ADF ranged from 30.7 to 39.7, with a mean of 32.6. NDF ranged from 42.6 to 60.7, with a mean of

49.4. As in the first seeding date, common rye had the highest ADF and NDF, and Stockford awnless barley had the lowest NDF. RFV ranged from 89 to 141, with a mean of 121. RFQ values ranged from 88 to 144, with a mean of 119. Common rye had the lowest RFV and RFQ, similar to its performance from the first seeding date.

Summary

Grain Harvest Trial

Grain yields and crop survival tended to be higher from the first seeding date. For the first seeding date, three of the twelve varieties could not be harvested regardless of fertilizer/herbicide treatment, while two other varieties could not be harvested where herbicide and fertilizer were not applied. For the second seeding date, five of the twelve varieties could not be harvested regardless of fertilizer/herbicide treatment. In both cases, the winter triticale and the oat varieties were not harvested, indicating that these are not good choices for a dryland spring grain crop in this region. It was also evident that Stephens winter wheat and Strider facultative barely can only produce a dryland grain crop when seeded early enough in the growing season to undergo vernalization.

The common rye seemed to perform the best under non-irrigated conditions, and the addition of fertilizer and/or herbicide did not have much of an effect on yield. However, common rye from the first seeding date tended to have higher yield, test weight, and percentages of good seed, so early seeding may be beneficial even for rye. Common rye was also the only entry with no weed pressure in any of the fertilizer/herbicide treatments, demonstrating its excellent competitiveness.

Although the differences were usually not statistically significant, it appeared that yields were increased with the use of herbicides. Fertilizer did not seem to have much of an effect. In the plots that received fertilizer but no herbicide, visually it appeared that the fertilizer to helped the weed growth and vigor more than the grain crop, doing more harm than good.

Forage Harvest Trial

The overall average forage yield was similar between the two seeding dates, but some varieties performed better from the early seeding date, while others yielded higher from the later seeding date. Overall quality was not dramatically different between the two seeding dates. In general, the varieties with high quality (relative to the others) from the first seeding date usually also had high quality from the second seeding date.

There was sufficient forage biomass to allow all entries from both seeding dates to be harvested as forage, indicating that certain varieties that were not suited for dryland grain production may be able to produce a dryland forage crop. As with the grain trials, the common rye produced the highest forage yield for both seeding dates. However, it also had the lowest CP, RFV, and RFQ values for both seeding dates.

Even though a very similar (yet simpler) study was conducted in 2001, it would be useful to duplicate these studies again in the future because different grain varieties were used, as well as different seeding rates. It would also be beneficial to see if year-to-year weather differences have an effect on forage and grain yields. Studies on other soil types (such as the drained lake bottom soils also often used in grain, potato, and alfalfa production) would also be useful, as weed pressure and potential moisture availability from shallow water tables may be different in those situations than in the upland mineral soils used in this study.

Conclusion

This study showed that, with minimal inputs, a non-irrigated, spring-seeded cover crop can be grown successfully to minimize weeds and wind erosion on upland mineral soils in the Klamath Basin. Once it has served those purposes, some varieties of spring-seeded cereals can then potentially be harvested as forage or grain, although yields are of course expected to be lower than the same crop would typically be with irrigation. Yields are increased and weed pressure is reduced with the addition of herbicides. The addition of herbicide was generally more beneficial to crop growth and yield than the addition of fertilizer. There are several viable cropping options, depending on the end result desired by the grower. Time of seeding and likely end-use (grain vs. forage) are important factors to consider for some of the varieties tested here, as some varieties only performed well under certain conditions.

References

Clark, D. R. and J.E. Smith. 2002. Early spring establishment of cereals for dryland cover crops and their production potential. Oregon Agricultural Experiment Station Special Report 1042. http://oregonstate.edu/dept/kbrec/publicationsannual-reports.

NIRS Forage and Feed Testing Consortium, June 2007 grass hay calibration, file name: gh50-2. Parameters used: DM, CP, ADF, dNDF48, NDF, Ca, P, K, Mg, Ash.

Undersander, D. and J.E. Moore. 2002. Relative Forage Quality. Focus on Forage, Vol. 4, No. 5. University of Wisconsin Extension, 2 pp.

US Bureau of Reclamation, 2009. Agrimet: The Pacific Northwest cooperative agricultural weather network. http://www.usbr.gov/pn/agrimet/.

Table 1. 2010 Dryland Grain Trial: Grain yield & agronomic factors for mineral soil, first seeding date (March 19). Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Type	Fertilizer x Herbicide Treatment	Yield (lb/ac)	Test Wt (lb/bu)	Weed Rating	Good Seed (%)	Barley Plumpness (6/64 %)	Yield Rank
102Triticale	Winter Triticale	A	0	-	5.0	-	na	34
102Triticale		B	0	-	1.7	-	na	34
102Triticale		C	0	-	0.0	-	na	34
102Triticale		D	0	-	6.7	-	na	34
Alpowa	Wheat	A	1851	59.5	10.0	76.1	na	9
Alpowa		B	1927	60.4	5.0	96.0	na	8
Alpowa		C	2070	60.4	0.0	95.7	na	7
Alpowa		D	1437	58.8	13.3	71.5	na	15
Baronesse	Barley	A	923	46.7	20.0	58.2	86.7	24
Baronesse		B	734	47.4	6.7	95.0	83.8	28
Baronesse		C	951	47.4	5.0	95.7	80.7	23
Baronesse		D	1244	49.2	15.0	78.3	89.0	19
Cayuse	Oat	A	0	-	83.3	-	na	34
Cayuse		B	0	-	56.7	-	na	34
Cayuse		C	0	-	56.7	-	na	34
Cayuse		D	0	-	90.0	-	na	34
Charisma	Oat	A	0	-	56.7	-	na	34
Charisma		B	0	-	18.3	-	na	34
Charisma		C	0	-	8.3	-	na	34
Charisma		D	0	-	56.7	-	na	34
Merlin	Awnless	A	764	50.1	11.7	82.4	na	27
Merlin	Triticale	B	1249	50.2	5.0	92.5	na	17
Merlin		C	802	49.7	5.0	91.7	na	26
Merlin		D	895	50.1	33.3	69.6	na	25
Metcalfe	Malting Barley	A	0	-	50.0	-	-	34
Metcalfe		B	452	49.0	15.0	95.0	83.1	31
Metcalfe		C	700	49.2	8.3	96.3	85.5	29
Metcalfe		D	471	50.7	50.0	82.5	86.0	30
Rye	Common	A	4999	58.1	0.0	96.6	na	2
Rye		B	4749	57.1	0.0	96.4	na	4
Rye		C	4982	57.1	0.0	96.3	na	3
Rye		D	5381	57.6	0.0	95.7	na	1
Stephens	Winter Wheat	A	1730	54.9	5.0	88.7	na	11
Stephens		B	2072	56.1	0.0	95.2	na	6
Stephens		C	1634	55.7	0.0	94.4	na	13
Stephens		D	1409	55.2	20.0	71.3	na	16
Stockford	Awnless Barley	A	0	-	53.3	-	-	34
Stockford		B	100	44.8	26.7	82.2	87.1	33
Stockford		C	283	41.4	16.7	81.8	89.4	32
Stockford		D	0	-	56.7	-	-	34
Strider	Facultative	A	2341	44.6	5.0	83.9	72.8	5
Strider	Barley	B	1548	44.4	0.0	92.5	81.8	14
Strider		C	1675	44.0	0.0	89.8	80.7	12
Strider		D	1734	45.2	13.3	74.7	83.9	10
Twin	Awnless Wheat	A	1135	55.1	11.7	77.7	na	20
Twin		B	1248	55.8	5.0	91.9	na	18
Twin		C	1074	55.9	3.3	96.0	na	21
Twin		D	1010	56.2	23.3	67.7	na	22
Mean			1150	52.5	19.4	87.3	83.4	
***P* (Treatment)**			**0.996**	**0.927**	**0.017**	**0.004**	**0.635**	
LSD (0.05)- Treatment			NSD	NSD	13.7	8.0	NSD	
CV Treatment (%)			96.3	4.5	122.6	9.3	11.2	
***P* (Variety)**			**<0.001**	**<0.001**	**<0.001**	**0.001**	**0.240**	
LSD (0.05)- Variety			358	1.6	9.4	7.5	NSD	
CV Variety (%)			40.0	2.7	59.6	9.8	8.9	
***P* (Treatment X Variety Interaction)**			**0.931**	**0.899**	**0.022**	**0.033**	**0.712**	

Treatment A: No Fert, No Herbicide
Treatment B: No Fert, With Herbicide
Treatment C: With Fert, With Herbicide
Treatment D: With Fert, No Herbicide

Table 2. 2010 Dryland Grain Trial: Grain yield & agronomic factors for mineral soil, second seeding date (April 16). Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Type	Fertilizer x Herbicide Treatment	Yield (lb/ac)	Test Wt (lb/bu)	Weed Rating	Good Seed (%)	Barley Plumpness (6/64 %)	Yield Rank
102Triticale	Winter Triticale	A	0	-	3.3	-	na	29
102Triticale		B	0	-	0.0	-	na	29
102Triticale		C	0	-	0.0	-	na	29
102Triticale		D	0	-	5.0	-	na	29
Alpowa	Wheat	A	1890	60.6	3.3	84.6	na	7
Alpowa		B	3193	62.3	0.0	95.5	na	5
Alpowa		C	2599	61.4	0.0	95.3	na	6
Alpowa		D	1743	58.8	3.3	80.2	na	8
Baronesse	Barley	A	370	45.7	23.3	80.6	80.2	24
Baronesse		B	555	44.7	3.3	91.1	78.8	17
Baronesse		C	547	46.3	1.7	93.6	79.2	18
Baronesse		D	425	44.0	18.3	48.3	80.3	21
Cayuse	Oat	A	0	-	35.0	-	na	29
Cayuse		B	0	-	23.3	-	na	29
Cayuse		C	0	-	6.7	-	na	29
Cayuse		D	0	-	15.0	-	na	29
Charisma	Oat	A	0	-	23.3	-	na	29
Charisma		B	0	-	8.3	-	na	29
Charisma		C	0	-	1.7	-	na	29
Charisma		D	0	-	20.0	-	na	29
Merlin	Awnless	A	983	48.8	5.0	73.7	na	15
Merlin	Triticale	B	1329	50.3	1.7	91.9	na	12
Merlin		C	1460	49.8	0.0	90.3	na	10
Merlin		D	1072	47.1	5.0	57.6	na	14
Metcalfe	Malting Barley	A	401	47.0	23.3	59.6	80.3	23
Metcalfe		B	498	47.2	13.3	93.5	83.9	19
Metcalfe		C	452	46.9	3.3	92.1	83.2	20
Metcalfe		D	406	46.3	16.7	59.7	82.4	22
Rye	Common	A	5027	56.6	0.0	95.1	na	1
Rye		B	4986	56.9	0.0	95.8	na	2
Rye		C	4694	56.9	0.0	95.2	na	3
Rye		D	4335	56.2	0.0	94.8	na	4
Stephens	Winter Wheat	A	0	-	5.0	-	na	29
Stephens		B	0	-	0.0	-	na	29
Stephens		C	0	-	0.0	-	na	29
Stephens		D	0	-	3.3	-	na	29
Stockford	Awnless Barley	A	118	41.8	45.0	69.6	90.2	26
Stockford		B	61	-	30.0	84.5	86.6	28
Stockford		C	123	37.4	15.0	75.1	87.6	25
Stockford		D	89	-	43.3	29.1	84.3	27
Strider	Facultative	A	0	-	8.3	-	-	29
Strider	Barley	B	0	-	0.0	-	-	29
Strider		C	0	-	0.0	-	-	29
Strider		D	0	-	3.3	-	-	29
Twin	Awnless Wheat	A	884	56.6	10.0	89.9	na	16
Twin		B	1735	57.0	3.3	91.8	na	9
Twin		C	1412	56.4	0.0	93.8	na	11
Twin		D	1218	54.4	6.7	65.4	na	13
Mean			888	52.4	9.1	82.5	82.0	
***P* (Treatment)**			**0.153**	**0.023**	**0.003**	**0.004**	**0.975**	
LSD (0.05)- Treatment			NSD	1.4	4.8	6.6	NSD	
CV Treatment (%)			50.5	2.7	92.1	18.2	7.2	
***P* (Variety)**			**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.207**	
LSD (0.05)- Variety			291	1.2	5.6	10.1	NSD	
CV Variety (%)			40.5	2.5	75.9	13.5	4.8	
***P* (Treatment X Variety Interaction)**			**0.243**	**0.483**	**0.025**	**0.130**	**0.902**	

Treatment A: No Fert, No Herbicide
Treatment B: No Fert, With Herbicide
Treatment C: With Fert, With Herbicide
Treatment D: With Fert, No Herbicide

Table 3. 2010 Dryland spring grain trial: Forage results for first seeding date (March 19) on mineral soil. Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Type	Fertilizer x Herbicide Treatment	Forage Yield O.D. (lb/ac)	CP	ADF	NDF	RFV	RFQ	Forage Yield Rank
102Triticale	Winter Triticale	B	3115	14.6	32.6	51.1	116	126	15
102Triticale		C	3191	13.3	34.1	51.8	112	118	13
Alpowa	Wheat	B	3238	11.8	30.1	47.7	128	130	11
Alpowa		C	3533	10.9	30.5	46.8	130	123	9
Baronesse	Barley	B	3148	11.6	32.2	51.2	116	122	14
Baronesse		C	3597	10.7	31.8	53.0	113	122	8
Cayuse	Oat	B	1491	11.2	32.4	44.2	134	104	24
Cayuse		C	1524	11.1	31.8	47.9	125	107	23
Charisma	Oat	B	3208	11.7	33.1	49.4	119	106	12
Charisma		C	2747	10.3	33.3	50.7	116	101	18
Merlin	Awnless	B	3616	10.4	32.0	50.1	119	106	7
Merlin	Triticale	C	3304	11.0	31.8	50.6	118	113	10
Metcalfe	Malting Barley	B	2356	11.9	32.4	51.0	116	124	20
Metcalfe		C	2637	11.5	33.1	52.4	112	120	19
Rye	Common	B	7587	9.3	38.4	58.1	95	86	2
Rye		C	9395	9.7	38.4	58.3	94	85	1
Stephens	Winter Wheat	B	4860	10.4	28.7	46.9	132	116	5
Stephens		C	4172	13.1	30.6	48.5	125	124	6
Stockford	Awnless Barley	B	2047	12.7	33.2	45.6	129	122	21
Stockford		C	1902	12.4	32.2	46.8	128	127	22
Strider	Facultative Barley	B	6397	11.2	30.3	48.1	126	119	4
Strider		C	6843	9.7	30.6	48.3	126	107	3
Twin	Awnless Wheat	B	2903	12.9	30.8	48.1	126	129	16
Twin		C	2828	13.4	31.5	48.5	124	127	17
Mean			3755	11.5	32.5	50.0	119	115	
***P* (Treatment)**			**0.276**	**0.336**	**0.370**	**0.032**	**0.001**	**0.460**	
LSD (0.05)- Treatment			NSD	NSD	NSD	0.7	0.4	NSD	
CV Treatment (%)			9.1	4.8	2.4	1.3	0.3	6	
***P* (Variety)**			**<0.001**	**0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	
LSD (0.05)- Variety			1003	2.0	1.4	2.4	7	13	
CV Variety (%)			18.3	13.3	3.3	3.6	4.7	7.8	
***P* (Treatment X Variety Interaction)**			**0.349**	**0.842**	**0.748**	**0.901**	**0.973**	**0.814**	

Treatment B: No Fert, With Herbicide
Treatment C: With Fert, With Herbicide

Table 4. 2010 Dryland spring grain trial: Forage results for second seeding date (April 16) on mineral soil. Klamath Basin Research & Extension Center, Klamath Falls, OR.

Entry	Type	Fertilizer x Herbicide Treatment	Forage Yield O.D. (lb/ac)	CP	ADF	NDF	RFV	RFQ	Forage Yield Rank
102Triticale	Winter Triticale	B	4061	14.3	32.5	48.2	123	133	9
102Triticale		C	3192	16.2	30.5	46.2	131	144	13
Alpowa	Wheat	B	5672	10.7	32.1	48.3	123	114	4
Alpowa		C	4426	11.1	30.0	47.2	129	123	8
Baronesse	Barley	B	3424	12.2	31.5	49.7	120	124	11
Baronesse		C	2890	12.1	31.2	50.7	118	126	16
Cayuse	Oat	B	1955	12.2	32.3	49.1	121	122	22
Cayuse		C	2325	10.4	32.2	49.3	120	111	19
Charisma	Oat	B	2763	12.6	32.8	48.2	122	117	17
Charisma		C	2259	12.1	32.4	49.0	121	121	20
Merlin	Awnless Triticale	B	3211	12.6	32.3	51.6	115	116	12
Merlin		C	3027	12.7	33.5	53.2	110	111	14
Metcalfe	Malting Barley	B	2890	11.9	32.9	49.2	120	118	15
Metcalfe		C	2619	13.8	32.2	50.1	118	124	18
Rye	Common	B	7007	10.8	39.7	60.7	89	88	2
Rye		C	7423	11.4	38.2	58.9	93	92	1
Stephens	Winter Wheat	B	2188	16.2	31.8	46.3	129	140	21
Stephens		C	3482	11.9	32.2	47.7	124	127	10
Stockford	Awnless Barley	B	1930	13.6	31.9	42.6	141	126	23
Stockford		C	1401	12.7	32.0	43.5	138	127	24
Strider	Facultative Barley	B	5688	11.6	32.6	50.7	116	117	3
Strider		C	5097	12.0	31.5	49.7	120	119	6
Twin	Awnless Wheat	B	4912	9.5	30.7	45.9	132	113	7
Twin		C	5278	11.0	30.9	47.9	126	119	5
Mean			3704	12.3	32.6	49.4	121	119	
***P* (Treatment)**			**0.090**	**0.749**	**0.132**	**0.556**	**0.935**	**0.261**	
LSD (0.05)- Treatment			NSD	NSD	NSD	NSD	NSD	NSD	
CV Treatment (%)			6.8	2.9	2.8	2.9	4.0	2.5	
***P* (Variety)**			**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	
LSD (0.05)- Variety			1053	1.7	1.3	2.0	7	8	
CV Variety (%)			25.2	11.3	3.3	3.4	4.7	6.1	
***P* (Treatment X Variety Interaction)**			**0.641**	**0.027**	**0.313**	**0.511**	**0.526**	**0.186**	

Treatment B: No Fert, With Herbicide

Treatment C: With Fert, With Herbicide

Fig. 1: KBREC Dryland Small Grain Trial- Precipitation & Timing of Key Activities 2010