Specialty Spring Barley Variety and Nitrogen Rate Trials across Northeastern Oregon

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Abstract

Five varieties of spring barley, Camas, Baronesse, Merlin, Salute, and YU599-06 were grown in locations in Union and Wallowa Counties in 2007, 2008, and 2009. Camas and Baronesse are commonly grown feed barley cultivars. Merlin, Salute and YU599-06 are waxy lines that have high beta glucans. Yields of feed types were compared to waxy lines. Under dryland conditions Merlin and Salute yield similar to Camas and Baronesse. Under irrigation all lines yielded similar to feed barley. Higher rates of nitrogen above the grower's customary rate did generally increase yield and often reduced test weight. Overall the most adopted lines of waxy barley will yield equal to feed barley. However, specific performance of waxy cultivars was different under irrigated and dryland management.

Keywords: feed barley, nitrogen, waxy barley

Introduction

Barley is the world's fourth largest cereal crop. In Oregon, barley has traditionally been grown as a feed grain or for malting purposes. Feed barley is second to wheat as the most commonly grown small grain in Oregon. The acreage of feed barley fluctuates with market prices. In dryland areas, feed barley has been the most dominant rotation crop with wheat. Malting barley, though higher in price, has been grown to a lesser extent because of a much smaller market, the need to contract acres, and the requirements for meeting plumpness and protein standards.

Over the past several years there has been increased interest in food barley. Food barley has waxy starch that is high in soluble dietary fiber, especially beta-glucans. Human consumption of soluble fiber from barley is an effective way of lowering serum cholesterol (Ames et al. 2006; Ames and Rhymer 2008). One proposed use of waxy barley grown in the region would be fractionation to produce soluble fiber to provide ingredients in various food products. Less valuable fractions would be converted to ethanol by either fermentation or gasification to be blended with gasoline for liquid motor fuel. Thus waxy type barley due to its health benefits and use as a human food would have a higher market price compared to feed barley.

Although much is known about feed and malting barley, very little is known about the performance and management of waxy barley in northeast Oregon. Waxy cultivars have not been routinely grown in variety trials so little information is available to growers. In addition, waxy cultivars may respond differently to applied nitrogen. Two critical production needs for growers are the evaluation of available waxy cultivars and better understanding of management of nitrogen for yield and quality characteristics. Norberg et al. (2009) investigated irrigated production of waxy barley cultivars. They studied irrigated production of fall-planted spring-type waxy barley cultivars coupled with nitrogen application and use of plant growth regulators

to control lodging. Rey et al (2009) studied waxy barley in dryland conditions in Pendleton. They demonstrated the need to manage nitrogen for quality and agronomic performance.

The purpose of our trials was to determine the response of nitrogen on spring sown waxy barley in dryland and irrigated conditions in Union and Wallowa counties. Performance of waxy barley was compared to commonly grown feed barley.

Materials and Methods

We established trials in Union and Wallowa Counties in 2007, 2008, and 2009 to evaluate the agronomic performance and grain quality of three waxy barleys and two widely grown spring feed barleys (Table 1). Trials were conducted under dryland conditions in Union County and under irrigation in Wallowa County (Table 2). To investigate N fertilizer interactions with grain yield, two nitrogen fertilizer rates were applied to each variety. A "customary "rate (rate used by the grower for feed barley) and a "high" (usually an additional 25 lb/acre) rate were used to determine if increased nitrogen would improve protein and beta glucan content. Sowing date of the trials varied from April to May depending on location, year and weather conditions (Table 3). Prior to planting, plot areas were prepared by grower cooperators with an application of glyphosate and each grower's residue management operation. Plots were sown in a randomized complete block design with four replications using a Fabro direct seed plot drill with Atom jet C-shank openers on 12-inch centers (Figure 1). Nominal planting depth was 1 inch. Cooperators supplied the tractor to pull the drill. Fifty pounds of granular 16-20-0-14 were placed with the seed and additional N to reach the treatment level was placed 2 inches below and to side of the seed as dry 46-0-0 through disk applicators on the drill. Varieties were sown at a rate of 25 seed/ ft^2 (Table 1). Plots were harvested with a Hege 140 plot combine with de-awning bars installed in the concave. Yields were determined from harvest weights and plot dimensions. Test weight on barley grain was determined. Quality characteristics of percent protein, waxy starch, and beta glucan are being determined in the laboratory. This paper reports only yield and test weight results.

Table 1. Barley varieties and characteristics.

Variety	Description	Origin	Seeds/lb	Sowing rate lb/acre @ 25 seed/ft^2
Baronesse	Hulled, non-waxy, 2-row, feed barley	WestBred	10,485	104
Camas	Hulled, non-waxy, 2 row, feed barley	Univ. Idaho	11,611	94
Merlin	Hull-less, waxy, 2-row barley	WestBred	10,879	100
Salute	Hulled, waxy, 2-row, high beta glucan	WestBred	9,271	117
YU 599-06	Hulled, waxy, 6 row, high beta glucan	WestBred	9,863	110

Table 2. Cooperators and N rates used in the studies

Year	Cooperator	Nitrogen Fertility Treatments (lb/acre) Customary	High+
Union County (dryland)			
2007	Elwyn Bingaman	100	130
2008	TRICO Farms	75	100
2009	TRICO Farms	75	100
Wallowa County (irrigated)			
2007	Alan Klages	100	130
2008	Melville Farms	93	118
2009	Melville Farms	93	118

Table 3. Soil test values and planting and harvest dates of trials.

Year	Location	pH	Available Nitrogen* lb/acre	Phosphorus (ppm)	Sulfur (ppm)	Planting Date	Harvest Date
Union County							
2007	Bingaman	--	--	--	--	4/13	8/7
2008	Trico	6.8	104	38	14.9	4/10	8/8
2009	Trico	7.1	156	33	15.9	4/8	8/4
Wallowa County							
2007	Klages	--	--	--	--	5/4	8/30
2008	Melville	6.0	189	35	21.6	4/19	9/8
2009	Melville	6.3	166	24	25.5	4/17	8/24

Figure 1. Fabro drill sowing trial TRICO Farms 2008

Results

Union County

Varieties responded differently between Union and Wallowa Counties, primarily because of irrigation. Due to this difference, each county's sites will be discussed individually. Yield and test weight results for Union County are shown in Table 4. In Union County, yields were similar in 2007 and 2008, but were much higher in 2009. Trial averages were 2,385, 2,778, and 4,940 respectively for 2007, 2008, and 2009. The lowest yield was Merlin at the high nitrogen rate in 2007 and highest yield was Baronesses at the high nitrogen rate in 2009 (Table 4). Test weights were highest in 2009, lowest in 2007 and intermediate in 2008. There were large differences in test weight from year to year. This may be due to weather conditions or location. Precipitation at the National Weather Service site at La Grande for crop years (September-July) for 2007, 2008 and 2009 was 16.42, 15.33 and 17.89 inches respectively.

Comparing yields of feed barley lines to waxy lines, Salute performed as well as the feed lines in all three years of the study in Union County. Merlin performed equal to the feed barley lines in two of three years and YU599 never yielded as well. Over the course of the study, additional nitrogen usually resulted in equal or lower yield and equal or lower and significantly reduced test weight. We suspect that this is due to high residual soil nitrogen levels at planting (Table 3). Test weights for Merlin were significantly different than other varieties. Merlin is a hull-less type so this was expected and cannot be used for comparison. Comparing the hulled types, YU599-06 consistently had lower tests weights than other waxy or feed cultivars.

Table 4. Yield and test weight, Union County trials, 2007, 2008, 2009.

	2007		2008		2009		Average	
	Yield Lb/a	Test wt. Lb/bu	Yield Lb/a	Test wt. Lb/bu	Yield Lb/a	Test wt. Lb/bu	Yield Lb/a	Test wt. Lb/bu
Baronesse	2388abc	50.6de	3129a	43.4ab	4972ab	54.1c	3496abc	49.4ab
Baronesse*	2738a	50.2ef	2677abc	40.7bc	5464a	54.0	3626a	48.3bc
Camas	2706a	52.2c	3097a	45.1a	4703ab	54.7	3502abc	50.7ab
Camas*	2499ab	51.1cde	2943ab	43.8ab	5034ab	54.5	3492agc	49.8ab
Merlin	2180bc	56.8a	2633abc	40.5bc	4721ab	60.6	3178bcd	52.6a
Merlin*	1962c	54.9b	2298c	37.6c	4639b	59.2	2966d	50.6ab
Salute	2840a	51.8cd	3036a	44.1ab	4810ab	54.5	3562ab	50.1ab
Salute*	2380abc	50.6de	2889abc	43.7ab	5088ab	54.2	3452abc	49.5ab
Yu599-06	2112bc	48.9fg	2745abc	37.1c	4962ab	49.3	3254abc d	45.1c
Yu599-06*	2045bc	48.3g	2348bc	38.1c	5044ab	48.9	3146cd	45.1c
LSD 0.05	471	1.6	627	4.3	765	1.1	384	4.2

*= high N rate

Wallowa County

Yield and test weight for irrigated trials in Wallowa County are shown in Table 5. Overall yields at the Klages site in 2007 were lower than at the Melville sites in 2008 and 2009. In 2007, the trial was planted later in the spring and the crop was less competitive with weeds. Trial averages were 4093, 5532, and 5818 lb/acre respectively for 2007, 2008, and 2009. All sites had wheel line irrigation. The lowest yield was YU599-06 at the customary nitrogen rate in 2007 and highest yield was YU599-06 at the high nitrogen rate in 2009 (Table 5). As might be expected, test weights under irrigated conditions in Wallowa County were more consistent. Overall, test weights were highest in 2007, lowest in 2009 and intermediate in 2008, although they typically varied at less than a pound per bushel.

Salute and Merlin (waxy types) yielded as well or better than feed barley cultivars in all three years. Yield of YU599-06 was less consistent. In comparison to the feed barley cultivars, it yielded similar in 2007, lower in 2008 and superior in 2009. The effect of additional nitrogen was inconsistent among years and varieties in regard to yield. In 2007, the higher nitrogen increased yields of Baronesse, Salute, and YU599. In 2008 and 2009 Baronesse and YU599 showed increased yield with the added nitrogen. Test weights tended to remain the same or to decrease slightly with added nitrogen.

Discussion

Union County

Results of this study varied between dryland sites in Union County and irrigated sites in Wallowa County. Waxy barley varieties performed differently in these two management systems (Tables 4 and 5). Under dryland conditions in Union County, the waxy cultivars, Merlin and Salute yielded similar to Camas and Baronesse, with Merlin yielding equal in all three years and Salute yielding equal in two of three years. However, YU599-06 consistently yielded less over the duration of the study. Because Merlin is hulless barley, its test weight cannot be

directly compared with the hulled types. Test weights of Salute consistently equaled those of the Camas and Baronesse. Test weights of YU599 were always lower than the other lines. Additional levels of nitrogen above the grower's customary rate generally resulted in equal or lower yields and usually lower test weight. Neither feed barley nor waxy barley responded to additional nitrogen. Soil test results (Table 3) showed the background levels of nitrogen were high. These levels of soil nitrogen suggest nitrogen can be used more judiciously in most years.

Wallowa County

Waxy barley lines responded differently under irrigation (Table 5). Merlin and Salute yielded similar to Camas and Baronesse in all three years of this study. YU599 yielded equal to or better than the feed barleys in 2007 and 2009, but less in 2008. Test weight of Salute where similar to test weights of Camas and Baronesse. In comparison, test weight of YU599 was consistently lower.

The high nitrogen rates showed inconsistent results among years and varieties. In 2007 Baronesse, Salute and YU599 showed increased yield. Baronesse and YU599 showed this in 2008 and 2009. However, the difference in yields between the high and customary rates is on the order of 200-300 lb/acre. At the current cost of N this amount of yield would not cover the cost of the additional N. Test weights did not decline with additional nitrogen, except for Camas, which had lower test weight in 2008 and 2009.

Table 5. Wallowa County Trials (Irrigated)

	2007		2008		2009		Average	
Variety	Yield lb/acre	Test wt. lb/bu	Yield lb/acre	Test wt. lb/bu	Yield lb/acre	Test wt. (lb/bu)	Yield (lb/acre)	Test wt. (lb/bu)
Baronesse	4410 ab	51.5 cd	5369 bc	51.2 bc	5765 c	48.7 cd	5182 ab	50.5 b
Baronesse*	4711 ab	52.7 bc	5501 abc	50.8 c	5697 c	48.1 d	5303 ab	50.5 b
Camas	4920 a	52.7 bc	5752 ab	52.3 b	5906 c	50.2 bc	5526 a	51.7 b
Camas*	4094 ab	52.7 bc	5536 abc	51.3bc	5286 de	47.6 de	4972 ab	50.6 b
Merlin	4148 ab	58.2 a	5658 abc	55.6 a	5701 c	52.4 a	5169 ab	55.4 a
Merlin*	3840 ab	58.4 a	5731 ab	55.4 a	5706 c	51.1 ab	5092 ab	55.0 a
Salute	3462 b	50.5 de	5165 cd	51.3bc	5580 cd	48.6 cd	4736 b	50.1 b
Salute*	4036 ab	53.1 bc	4850 d	50.9 c	5178 e	47.7 de	4688 b	50.6 b
YU599-06	3519 b	49.8 e	5809 ab	46.4 d	6403 b	45.3 f	5244 ab	47.2 c
YU599-06*	3788 ab	49.1 e	5952 a	46.1d	6962 a	45.9 ef	5568 a	47.2 c
LSD (0.05)	556	1.5	518	1.3	180	2.1	722	1.8

* denotes high N rate

Conclusions and Recommendations

Based on yields and test weights results of this study under both irrigated and dryland conditions we have the following conclusions and recommendations for growing waxy type barley cultivars.

1. Under dryland production, Salute and Merlin yield similar to Camas and Baronesse. Growers can expect similar yields with these lines. YU did not perform as well as the other waxy cultivars.
2. Under irrigated production all waxy lines performed equal to feed barley and Merlin and YU599, respectively, yield better in 2008 and 2009, respectively, than the feed barley cultivars.
3. Rates of nitrogen above the grower's customary rate are not warranted under either dryland or irrigated yields, where soil test levels are high. In this study, the results indicate that for waxy barley cultivars it is not necessary to increase N-rates to achieve similar grain yield obtained with standard feed-type cultivars. Growers can probably reduce customary rates of N by using timely soil tests. However, quality characteristics such beta glucan content or protein level may be are factors that improve with additional nitrogen.

This study indicates that adopted cultivars of waxy barley can yield similar to commonly grown feed barley cultivars. If there is an available market and higher or equal prices for waxy, growers could expect incomes higher or similar to feed barley. If waxy barley commands a higher price then growers can expect yields similar to feed barley and can budget based on historic feed barley yields and expected price.

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