Spring Small Grain Seeding Rate Trial at Lower Klamath Lake

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Abstract

A seeding rate trial was conducted on a site at Lower Klamath Lake (LKL), Oregon that had received pre season winter flooding as the only source of irrigation. This trial investigated two varieties each of spring barley, oats, and wheat, at seeding rates of 10, 20, 30, and 40 seeds/ft^2. Common practices in the area under winter flood and in-season irrigation would call for seeding rates of 30 seeds/ft^2. Highest yields from this trial tended to occur at seeding rates less than 40 seeds/ft^2. With increasing seeding rates, test weights increased while plant height and heading dates decreased.

Introduction

The winter flooding of crop land is a unique irrigation practice conducted on the high water-holding capacity soils of LKL. These high organic matter muck soils can hold upward of 5 in of water per foot of soil. Many of these soils are underlain with clay layers found at depths of 12 in or more. These semi-permeable clay layers tend to impede but not totally prevent water and root penetration. The high amounts of water applied during the winter floods restore water to the soil profile in addition to leaching accumulated salts away from crop rooting zones. In the past, it was a common practice for this winter flood to be the only irrigation water for the growing of spring-planted small grains. Yields approaching 3,000 lb/acre could be expected with this practice. More recently, in-season irrigation along with improved varieties and other agronomic techniques have doubled expected yields. A lingering drought and altered water allocation policy caused much of the LKL area to be denied in-season irrigation water during the 2001 growing season. This resulted in grain crops being grown only with the winter preseason flood.

Although this practice was common in earlier times, it was not known how the improved varieties of spring small grains would react to the more dryland conditions. Previous work has shown that winter cereals are capable of increasing seedhead tillers, compensating for low stand counts, with minimal loss of grain yields. However, with the shorter growing season of spring grains, tiller production is limited and stand populations are more correlated with yields. Most spring grain yield is produced from the main stem and the first tiller. Harvest problems arise when immature grain from later emerging tillers is combined with the mature majority of the grain.

To investigate these questions, a seeding-rate trial was established at LKL to determine appropriate seeding rates for spring barley, wheat, and oats. Moisture received during this trial totaled 0.58 in as recorded from the AgriMet Automated Weather Station located 2 miles from the trial site. This rainfall was received in 14 events. Only two of the events produced more than

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0.1 in of rain, with 0.11 in recorded on July 10 and 0.16 in recorded on August 9. Freezing temperatures occurred on 16 occasions during the test. The coldest temperatures were below 20°F on June 4 and June 13. Temperatures between 20 and 30°F were recorded on 7 nights and between 30 and 32°F on 7 nights.

Procedures

The trial was conducted on an Algoma silt loam soil in a continuous grain rotation. Spring small grain varieties evaluated included 1202 and Xena barley, Ajay and Cayuse oats, Alpowa soft white wheat, and Yecora Rojo hard red wheat. Grain was planted with a Kincaid plot planter on May 18, in a four by six randomized complete block factorial design with four replications. Seed was planted 2 in deep into moisture, at seeding rates of 10, 20, 30, and 40 seeds/ft^2. Differences in the density of the seeds among the varieties resulted in varying lb/acre of the seeds. The seeds/ft^2 seeding rates are converted to lb/acre in Table 1. Fertilizer included 70 lb N/acre shanked in before planting as anhydrous ammonia and 50 lb N, 63 lb P_2O_5, and 41 lb S/acre banded at planting (16-20-0-13 at 310 lb/acre).

During the growing season, the date to achieve 50 percent heading was noted and just prior to harvest, plant height and lodging percentages were recorded. Grain was harvested and yield recorded on September 12 with a Hege (Hans-Ulrich Hege) plot combine with a 4.5-ft-wide header. All samples were evaluated at the Klamath Experiment Station for test weights and moisture content. Grain yields were normalized to 10-percent-moisture levels. The barley samples were also graded to determine percent plumps and thins.

All data were analyzed using SAS software. In this experiment with quantitative seeding rates as treatments, parameters with significant differences were further analyzed with orthogonal polynomials to determine the form of regression analysis most applicable to fit the data. With all quadratic and cubic responses "Max R" multiple regression analysis was used to determine the most applicable polynomial equation to produce the most appropriate regression line.

Results and Discussion

Since quantitative levels of seeding rates were employed as treatments in this trial it is not appropriate to use statistical mean separation techniques to differentiate the results of the trial. However, for reference, the data are presented for yield, test weights, height, and heading date in Table 2. Interactions were exhibited between grain varieties and seeding rate for the 10-percent-moisture yields in this trial. Due to this interaction, grain varieties should be considered individually.

Significant regression curves between seeding rate and yield for the separate grain varieties are presented in Figure 1. Data from five of the six grain varieties produced significant regressions. For these five varieties, we noted an increase in yield that peaked either at the 20 or 30 seeds/ft^2 seeding rate. Yield then declined slightly at the higher seeding rate. Based on the regression equation, maximum yield of 5,030 lb/acre for 1202 barley would have been expected between 35 and 36 seeds/ft^2. Similarly, maximum yield of 5,610 lb/acre for Xena barley would have been expected between 32 and 33 seeds/ft^2; for Cayuse oats, maximum yield of 4,440 lb/acre would have been expected between 27 and 28 seeds/ft^2; for Alpowa wheat, maximum yield of 5,190 lb/acre would have been expected between 32 and 33 seeds/ft^2; and for Yecora Rojo wheat, maximum yield of 2,790 lb/acre would have been expected between 36 and 37 seeds/ft^2.

When evaluated against seeding rates, test weights for the grain varieties produced three significant regressions (Fig. 2). For varieties 1202 and Xena barley and Yecora Rojo wheat, test weights increased with increasing seeding rates. This is a bit confounding, as it seems more logical for test weights to be higher for treatments with fewer plants that would have a larger share of the available water and nutrients than for plots with a higher plant population. For percent plumps and thins, the two barley varieties exhibited no differences between varieties or among seeding rates.

Two significant regressions were found between cereal height and seeding rates (Fig. 3). Ajay oats and 1202 barley experienced decreased height with increasing seeding rates. This would be expected, as competition between plants at higher plant populations would tend to reduce plant height.

The comparison between heading date and seeding rate for both oat varieties produced significant regressions (Fig. 4). Increasing the number of plants caused the oats to reach 50 percent heading sooner. Again this is expected as limitations to moisture and nutrients generally stimulate reproductive activity.

Table 1. Seeding rates converted from seeds/ft^2 to lb/acre for barley, oat, and wheat varieties grown at a Lower Klamath Lake organic soil site in 2001.

	seeds/ft^2			
Variety	10	20	30	40
	lb/acre			
<u>Barley</u>				
1202	41	83	124	165
Xena	34	67	101	134
<u>Oats</u>				
Ajay	26	52	78	104
Cayuse	33	65	98	131
<u>Wheat</u>				
Alpowa	45	90	135	181
Yecora Rojo	44	88	133	177

Table 2. Grain yield, test weight, height, and heading dates for barley, oats, and wheat varieties at various seeding rates for cereals grown at Lower Klamath Lake, 2001.

Variety	Seeding rate	Yield	Test weight	Height	Heading date
	seeds/ft^2	lb/acre	lb/bu	in	Julian
<u>Barley</u>					
1202	10	3560	49.6	27	201
	20	3960	49.9	26	201
	30	4830	50.9	26	202
	40	4850	51.3	25	200
Xena	10	3260	49.3	27	201
	20	4850	51.5	25	202
	30	5620	51.5	25	201
	40	5350	52.3	25	199
<u>Oats</u>					
Ajay	10	3580	40.9	25	201
	20	3890	40.1	24	201
	30	3800	41.1	23	200
	40	4140	41.0	22	199
Cayuse	10	3540	39.5	30	200
	20	4440	39.0	31	198
	30	4270	39.6	29	198
	40	4050	39.5	28	196
<u>Wheat</u>					
Alpowa	10	3000	60.1	28	198
	20	4550	61.5	29	198
	30	5120	61.6	29	195
	40	4980	61.3	28	197
Yecora Rojo	10	1640	55.5	19	193
	20	1590	57.9	19	192
	30	2500	59.1	18	193
	40	2630	61.1	19	192

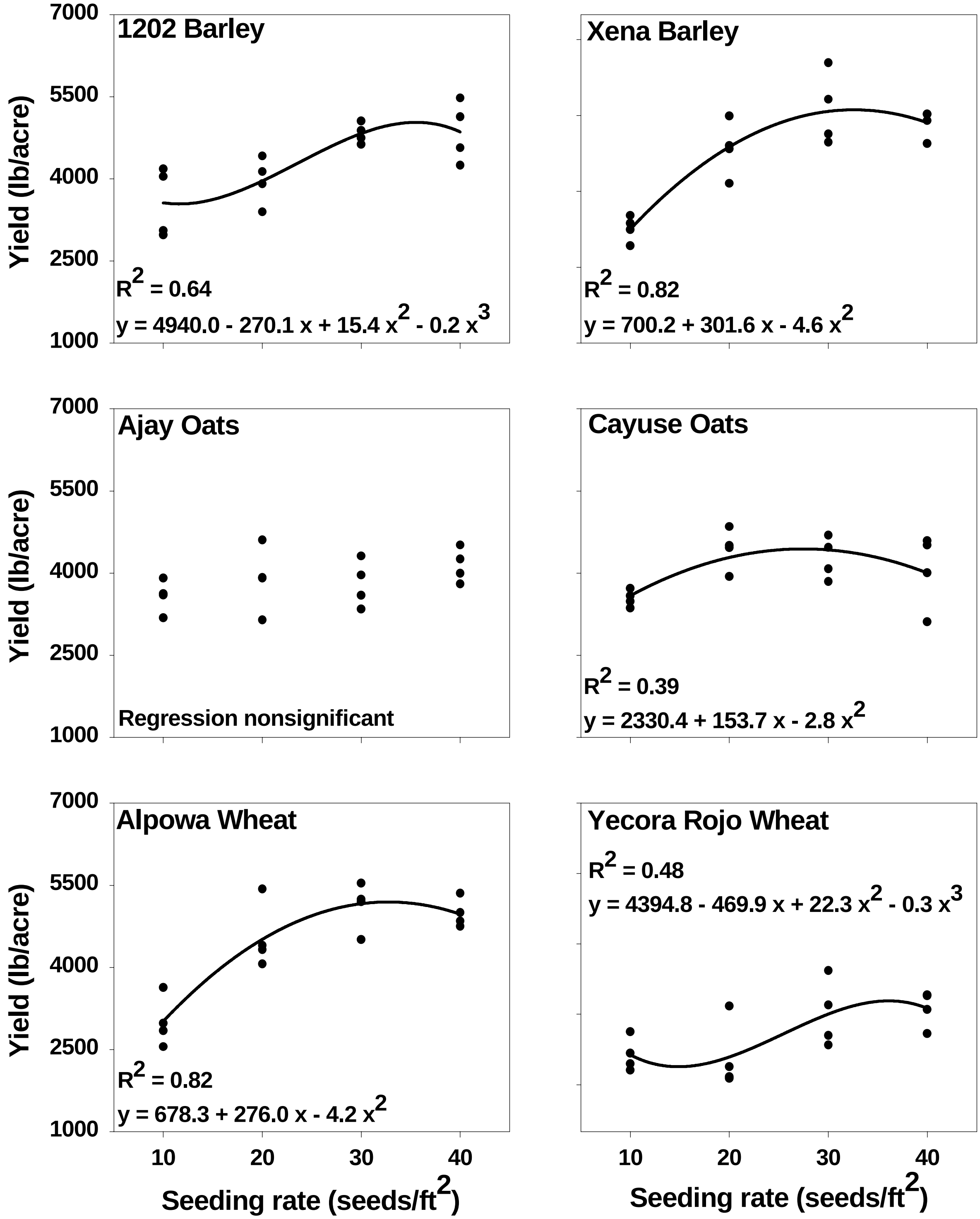

Figure 1. Regression analysis of cereal grain yields with different seeding rates, Lower Klamath Lake, OR, 2001.

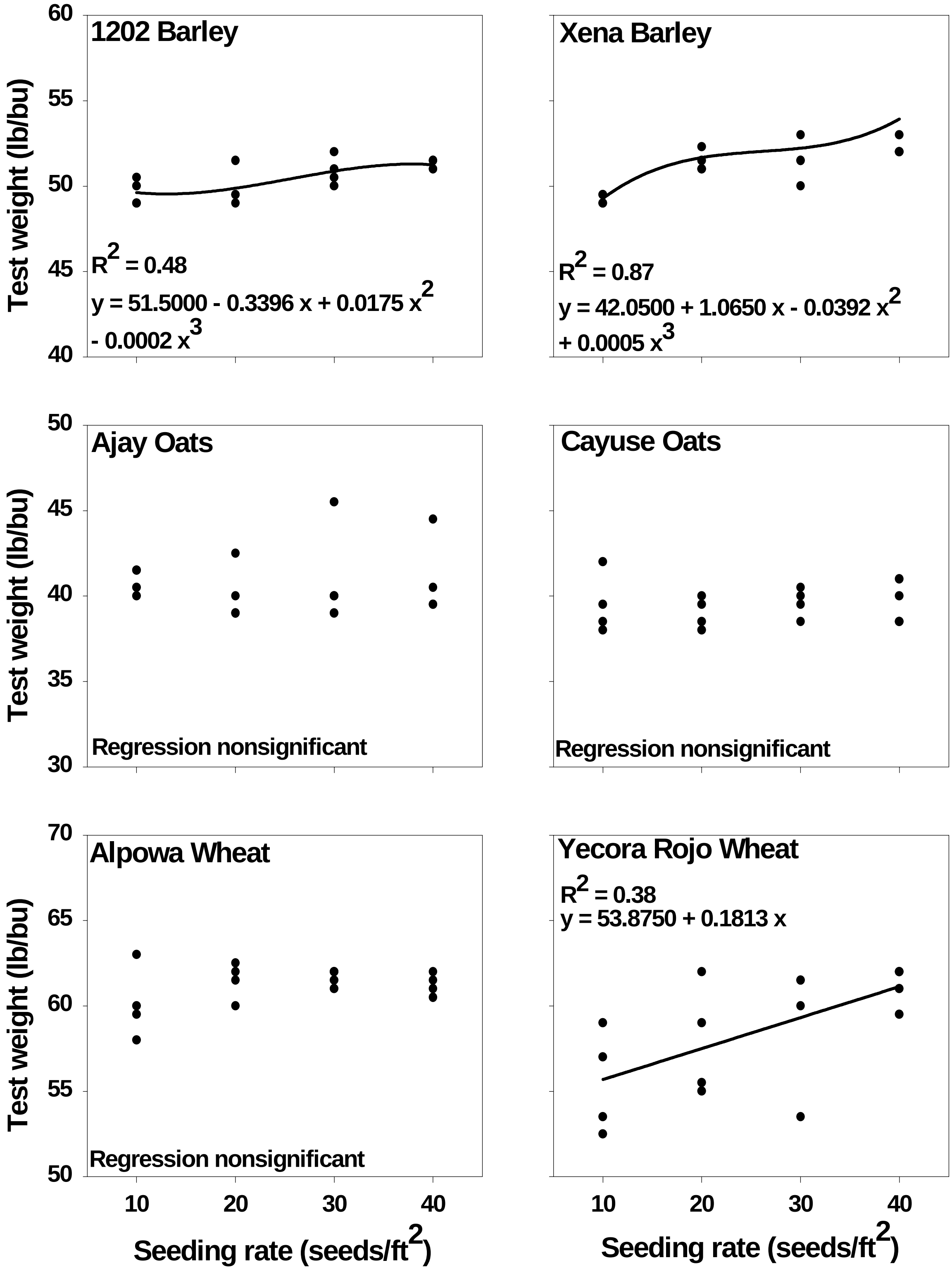

Figure 2. Regression analysis of cereal grain test weights with different seeding rates, Lower Klamath Lake, OR, 2001.

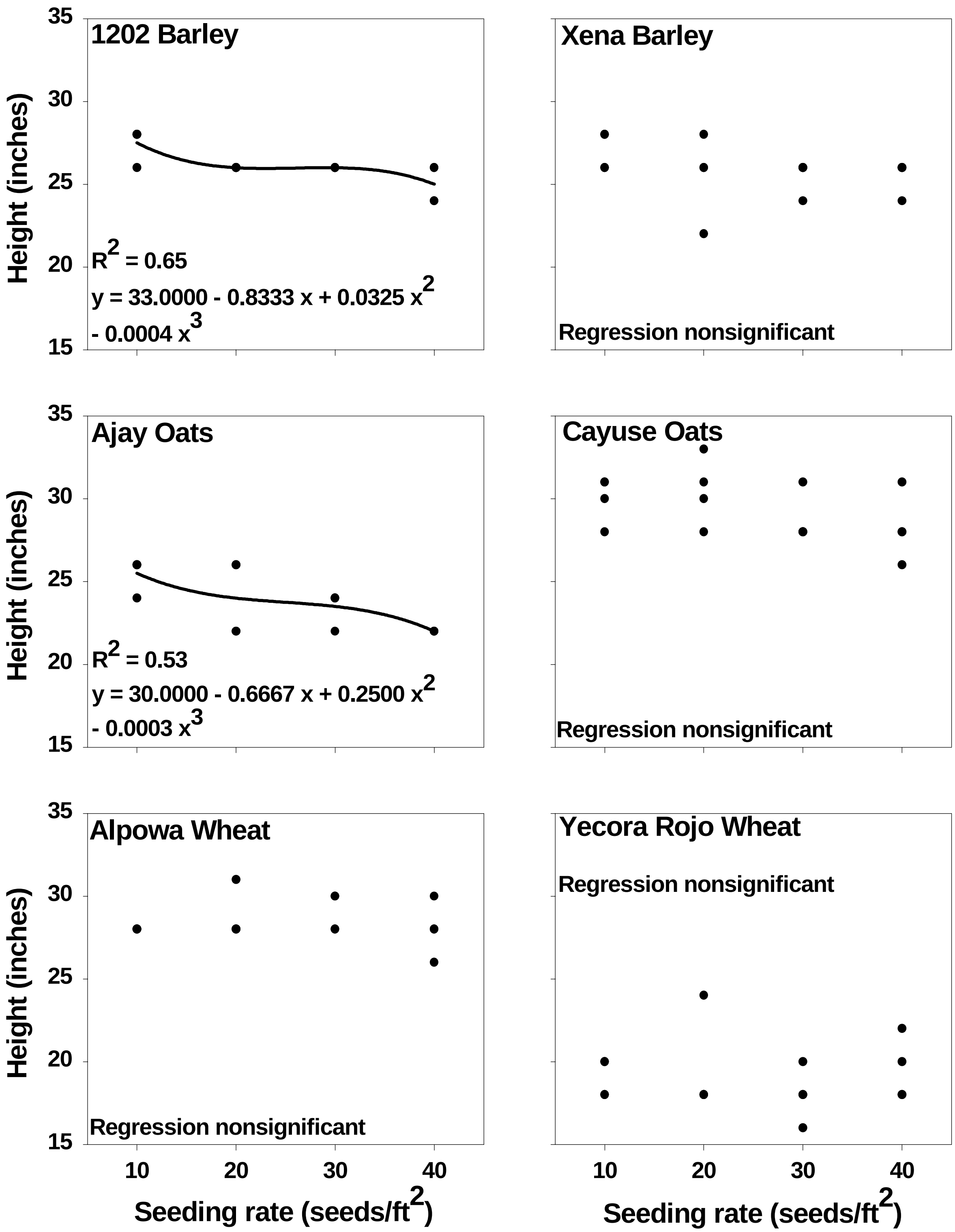

Figure 3. Regression analysis of cereal height with different seeding rates, Lower Klamath Lake, OR, 2001.

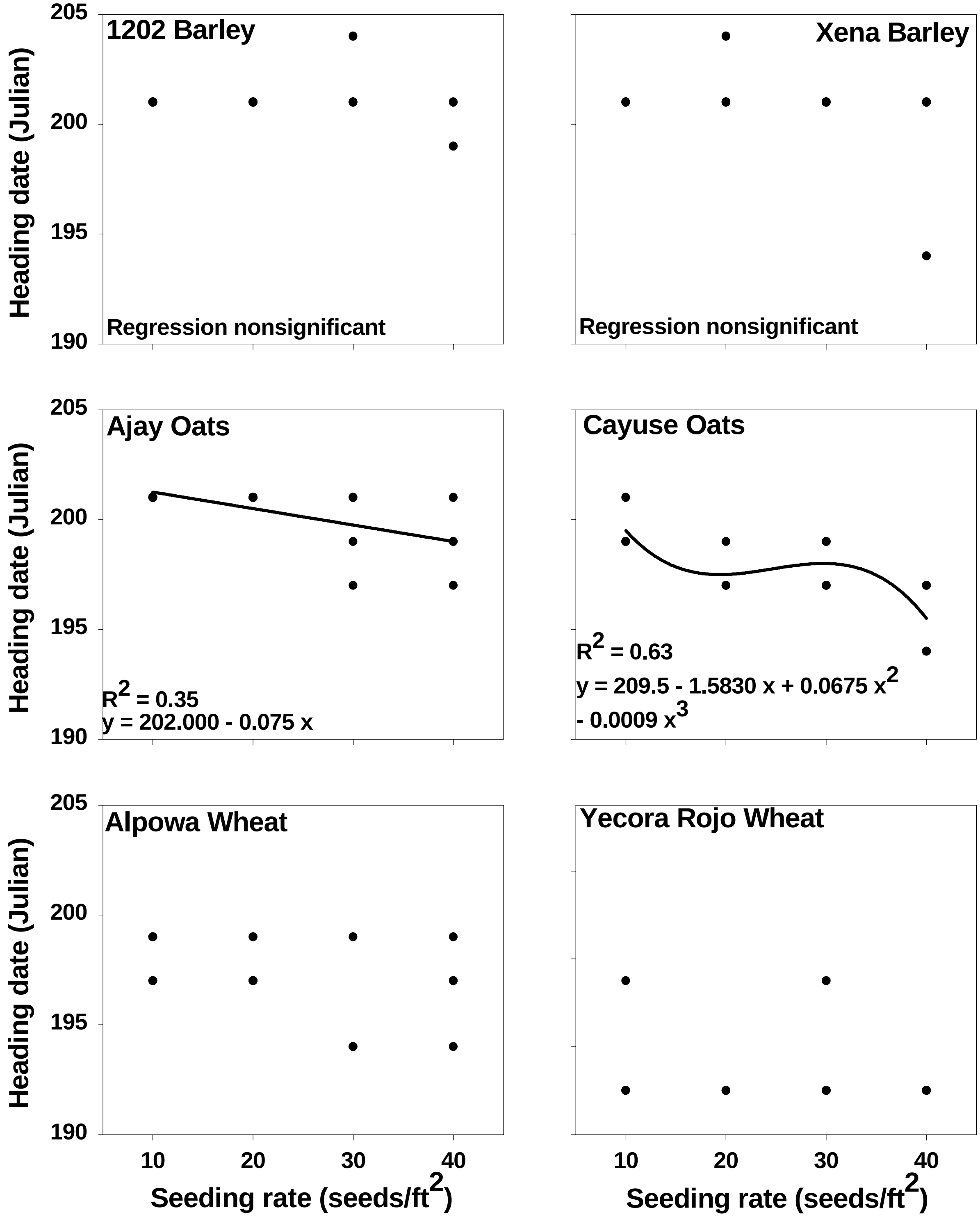

Figure 4. Regression analysis of cereal heading dates with different seeding rates, Lower Klamath Lake, OR, 2001.