Early Spring Establishment of Cereals for Dryland Cover Crops and Their Production Potential

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Abstract

With the drought and lack of irrigation water for the 2001 growing season, a need developed to provide cover for fields with insufficient plant residues to prevent wind erosion damage. Fields that had grown potatoes and onions the previous year were most vulnerable to springtime winds. To investigate the suitability of small grains for this purpose, plots were established on the mineral soil at the Klamath Experiment Station (KES) with eight small grain varieties. Entries included barley, wheat, rye, oats, and triticale. Both spring and winter varieties were seeded on April 16. Frosts after seeding caused leaf burn and some plant death. Cayuse oats had the most plant death due to these early frosts. An early vigor rating indicated that 102 winter triticale, Trical 2700 spring triticale, common winter rye, and Xena spring barley exhibited the most vigor. None of the three winter cereals produced reproductive tillers. They would have been most suitable for grazing and less for haying. For the heading varieties, Trical 2700 triticale and Xena barley produced the most hay from cuttings 9 and 11 weeks after seeding. The non-heading winter cereals produced higher forage quality than headed cereals. For the varieties that were hayed, Sprinter and Xena barley produced hay with higher forage quality than Trical 2700 triticale. Trical 2700 triticale produced the most grain, about 1 ton/acre, while Sprinter barley produced about 0.5 ton/acre.

Introduction

Concerns were raised about wind erosion with the announcement on April 6, 2001 that water from the Klamath Project would not be available to most irrigators during the 2001 growing season. Fields that had grown grain, hay, or other similar crops had adequate cover from vegetative residues to prevent wind erosion damage. The chief concern was fields that had grown potatoes or onions during the 2000 growing season or that were fall-prepared for 2001 row crops. At KES, two fields had grown potatoes in the 2000 season and by early April were beginning to lose topsoil. On April 16, a particularly windy day, a series of car accidents occurred due to blowing dust that reduced visibility on Highway 97, just north of Klamath Falls.

With the lack of potential income from dryland fields, the cost of establishing cover crops was a concern to producers. To alleviate these concerns, the Natural Resource Conservation Service (NRCS) provided two million cost-share dollars to implement a portion of the Emergency Watershed Protection (EWP) program. Over 29,000 acres of land were enrolled in this program in the Klamath Basin. This program provided between 30 and 40 dollars/acre for cover crop establishment, and allowed producers to harvest these acres provided 1,000

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lb/acre of vegetative residue remained. This allowed producers a chance to either hay or graze established cover crops.

A trial was established at KES to determine the most appropriate small grain to use for a non-irrigated cover crop and the production potential for such a crop. The trial included evaluations of early crop vigor, stand counts, yields from two forage hay harvests, forage quality for the second cutting, and grain yield.

Procedures

The trial was established on a field with Poe fine sandy loam soil that had grown potatoes the previous year. Residues from this crop had been raked and burned leaving the soil bare, with the potential for wind erosion damage. The field was ripped to 12- to 18-in depth in November, prior to cover crop establishment. Eight varieties in the trial included Xena spring barley, Sprinter facultative barley, Stephens soft white winter wheat, Twin hooded wheat, 102 winter triticale (hybrid between wheat and rye), Trical 2700 facultative triticale, Cayuse oats, and common winter rye. Grain was seeded on April 16, 2001 using a Great Plains direct-seeding drill into 14- by 600-ft plots. Seeding rate was 60 lb/acre with seeding depth 2-3 in to reach moisture. Three replications were used in a randomized complete block design.

Three weeks after seeding (WAS), visual vigor ratings and plant heights were measured on the plots. At 9 WAS, plant heights were measured and forage material was removed from two random 2.8-ft^2 quadrants by cutting 0.5 in above the soil surface. This material was dried for 48 hours at 140^oF to determine dry weight yields. A plant count was also completed at this time. During the trial, three of the cereals, Stephens winter wheat, 102 winter triticale, and the common winter rye, did not receive adequate vernalization conditions to produce reproductive tillers. Following the first quadrant harvest, the middle 9 ft of each plot of productive tillering entries was swathed and removed as hay. At 11 WAS, plant heights were measured from plot borders and from the regrowth from previously swathed plot centers. Forage material was harvested from the uncut and regrowth portions of plots and dried as above to obtain dry weight yields. Material was ground twice, once to pass a 2-mm-sieve screen with a Wylie Mill, and then to pass a 1-mm-sieve screen with a Udy Mill, and analyzed using a near infrared spectrophotometer (NIRS) to determine acid detergent fiber (ADF), neutral detergent fiber (NDF), and crude protein (CP). From these forage quality attributes, the total digestible nutrients (TDN) and relative feed value (RFV) were calculated. The formulas for these calculations are:

TDN = [82.38 – (0.7515 * ADF)] * 0.9

RFV = { [120 / NDF] * [88.90 – (0.779 * ADF)] } / 1.29

Grain from the uncut plot borders was harvested with a 4.5 ft-wide header Hege (Hans-Ulrich Hege) plot combine at 17 WAS. Grain from each plot was weighed for yield and test weights were determined from one replication for all varieties. In addition, plumps and thins were determined for the two barley varieties. All data were analyzed statistically using SAS software for a randomized complete block design.

Results and Discussion

The AgriMet station located at KES recorded total precipitation of 1.71 in during the trial. This included 0.57 in of rain 2 days after seeding (DAS) and 0.64 in 4 WAS. These rainfall events provided sufficient moisture for seed germination and plant establishment. Thirteen frosts occurred during the trial, including temperatures of 24^{o}F 13 DAS, 23^{o}F 16 DAS, and 26^{o}F 7 WAS. The last spring frost occurred 8 WAS. These frosts caused burning of leaf material and stand reductions.

Data collected 3 WAS on visual vigor ratings and plant heights are included in Table 1. The two triticale (manmade hybrids between wheat and rye) varieties and the winter rye demonstrated the most vigor among the eight cereals. This was evident both in the visual vigor ratings and in plant height measurements. This seems logical, as rye is known as one of the more cold-hardy cereals. On the other end of the scale, Cayuse oats was visibly the least vigorous and shortest of the tested cereals. Forage data from harvests completed 9 and 11 WAS further documented injury to oats (Table 2).

Height measurements of the cereals at the first forage harvest showed that Xena barley, Trical 2700 triticale, and Cayuse oats were the tallest. For reproductive cereals, Sprinter barley was significantly shorter than other reproductive cereals. Common rye, 102 triticale, and Stephens wheat did not produce seed heads and were shorter than those that did head out. The reduced height was also evident in the yield component for both harvests. Top forage yields for the first harvest were observed for Trical 2700 triticale, Xena barley, Twin wheat, and Sprinter barley.

A noticeable increase in height was observed for Trical 2700 triticale from the first to the second cutting. Variations in yields within plots due to water stress resulted in large coefficients of variation (CVs) and least significant differences (LSDs) (Table 2). As a result, none of the reproductive cereals were significantly different from each other in forage yield at 11 WAS. Trical 2700 triticale produced the tallest regrowth following the first harvest. However, this height advantage did not translate to increased regrowth forage yield. Though not the tallest, Twin wheat and Sprinter barley produced the highest amount of regrowth matter due to more shoots.

Though forage yields were less for the cereals that only produced vegetative growth, forage quality was better than for seed-producing varieties (Table 3). Among vegetative entries, the major difference in quality was that winter wheat and triticale exhibited higher CP than the rye. For heading entries, the two barley varieties produced less ADF and NDF than triticale. The increased height and thus increased stem material for triticale accounted for its higher fiber content.

Grain yields and quality for the cereals are reported in Table 4. Triticale produced significantly more grain (1,900 lb/acre) than other entries except Cayuse oats, while Sprinter barley produced the least at 930 lb/acre. Under irrigated conditions in the previous year's grain variety trials, Trical 2700 triticale and Cayuse oats both produced over 3 tons/acre.

Test weights for the Cayuse oats were similar to those observed in previous years under irrigation. Barley test weights averaged over 54 lb/bu in a 37-entry barley variety trial under irrigation in 2000. In the 2001 trial, Xena produced similar test weights, but Sprinter had lower test weights than in 2000 by over 7 lb/bu. However, in this trial Sprinter had more plumps than Xena (85 percent compared to 73 percent). In the 2000 trial, barley varieties averaged 95 percent plumps, indicating the dryland conditions definitely reduced the percentage of plumps compared to irrigated conditions last year.

Table 1. Cover crop vigor and height 3 weeks after seeding for eight cereal varieties grown at Klamath Falls, OR, 2001.

Type and (Variety)	Vigor	Height
	visual	in
Winter triticale (102)	9 a[1]	3 a
Facultative triticale (Trical 2700)	9 a	3 a
Winter rye (Common)	8 ab	3 a
Spring barley (Xena)	7 b	2 b
Spring hooded wheat (Twin)	5 c	2 b
Facultative barley (Sprinter)	4 c	2 b
Winter wheat (Stephens)	4 c	2 b
Spring oats (Cayuse)	2 d	1 c
Mean	6	2
CV (%)	12	14
LSD (0.05)	1	1

[1]Values within columns followed by the same letter are not significantly different (p = 0.05).

Table 2. Plant stands, cover crop height, and forage yield of eight cereal varieties 9 and 11 weeks after seeding (WAS) and height and forage yield of regrowth 11 weeks after seeding and 2 weeks after initial cutting at Klamath Falls, OR, 2001.

	9 WAS			11 WAS		Regrowth	
Type and (Variety)	Number	Height	Yield	Height	Yield	Height	Yield
	plant/ft^2	in	lb/acre	in	lb/acre	in	lb/acre
Facultative triticale (Trical 2700)	22 bc[1]	21 ab	5260 a	36 a	8660 a	15 a	270 c
Spring barley (Xena)	25 bc	23 a	3820 b	24 b	5950 a	10 ab	270 c
Spring oats (Cayuse)	14 d	19 abc	2670 cd	22 b	5930 a	7 b	480 b
Facultative barley (Sprinter)	29 ab	16 c	3120 bc	15 c	5850 a	11 ab	570 ab
Spring hooded wheat (Twin)	33 a	18 bc	3640 b	20 b	5530 ab	9 b	680 a
Winter rye (Common)	25 bc	11 d	2230 de	10 d	2890 bc	---	---
Winter triticale (102)	28 ab	8 d	1800 de	10 d	2540 c	---	---
Winter wheat (Stephens)	18 cd	9 d	2100 de	9 d	2160 c	---	---
Mean	24	16	3080	19	4890	10	460
CV (%)	19	15	14	13	32	26	18
LSD (0.05)	8	4	730	4	2760	5	160

[1]Values within columns followed by the same letter are not significantly different (p = 0.05).

Table 3. Cover crop forage quality of eight cereal varieties as acid detergent fiber (ADF), neutral detergent fiber (NDF), crude protein (CP), total digestible nutrients (TDN), and relative feed value (RFV) from cuttings 11 weeks after seeding at Klamath Falls, OR, 2001.

Type and (Variety)	ADF	NDF	CP	TDN	RFV
	%	%	%	%	
Winter wheat (Stephens)	23 a[1]	41 a	20 a	59 a	164 a
Winter rye (Common)	23 ab	42 a	17 bc	59 ab	157 a
Winter triticale (102)	23 ab	43 a	19 ab	59 abc	155 a
Facultative barley (Sprinter)	27 bc	50 b	15 cd	56 bcd	129 b
Spring barley (Xena)	27 bc	50 b	13 d	56 cd	128 b
Spring oats (Cayuse)	30 cd	53 bc	16 cd	54 de	116 bc
Spring Hooded Wheat (Twin)	30 cd	53 bc	15 cd	54 de	115 bc
Facultative triticale (Trical 2700)	34 d	58 c	14 cd	52 e	101 c
Mean	27	49	16	56	133
CV (%)	9	6	11	3	10
LSD (0.05)	4	5	3	3	22

[1]Values within columns followed by the same letter are not significantly different (p = 0.05).

Table 4. Cover crop grain yields and grain quality of eight cereal varieties grown at Klamath Falls, OR, 2001.

Type and (Variety)	Yield	Test weight	-----% above sieve-----		
			6/64	5.5/64	pan
	lb/acre	lb/bu			
Facultative triticale (Trical 2700)	1900 a[1]	54.5	---	---	---
Spring oats (Cayuse)	1670 ab	41.0	---	---	---
Spring barley (Xena)	1490 b	53.5	73	19	8
Spring hooded wheat (Twin)	1320 b	60.5	---	---	---
Facultative barley (Sprinter)	930 c	46.5	85	10	5
Winter triticale (102)	---	---	---	---	---
Winter rye (Common)	---	---	---	---	---
Winter wheat (Stephens)	---	---	---	---	---
Mean	1465	51.2	79	15	7
CV (%)	14	---	---	---	---
LSD (0.05)	370	---	---	---	---

[1]Values within a column followed by the same letter are not significantly different (p = 0.05).