



Research Report

Winter Cereal Variety Evaluation at Maricopa, 2019

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Summary

Winter cereals for forage were evaluated in small plots at the University of Maricopa Agricultural Center. The crop types evaluated were triticale, barley, wheat and oats. The trial was irrigated up on December 17, 2019. The forage was sampled eight times between each irrigation. Forage yield was measured along with percent leaf, stem, and head, plant height, head moisture and growth stage. Forage quality was measured by NIRS for two dates roughly corresponding to boot and soft dough depending on the variety.

Introduction

Winter cereals for forage are displacing durum for grain in many areas of Arizona due to the demands of the dairy and beef cattle industry. The University of Arizona has only sporadically tested winter cereals for forage. This trial was initiated at the request of the dairy industry and may be conducted annually depending on demand for this information and available funding.

Procedure

Winter cereal forage varieties were evaluated at Maricopa Agricultural Center. The seed was planted with a cone planter in plots 20 ft long in 10 rows spaced 7 inches apart. The seeding rate was approximately 130 lbs/acre. Two trials were planted in an randomized complete block design with 3 replications: 1) Triticale varieties only: 15 triticale varieties, 2) Winter cereal varieties: 4 barley, 4 oat, 1 wheat, and 1 triticale variety (common to the triticale experiment). Growing conditions are listed in Table 1.

The following data was collected for eight sampling times near each irrigation: forage yield (72% moisture basis), leaf, stem, and head percentage of the plant, plant height, head moisture (as an indication of maturity), and growth stage. The growth stage numeric code is presented in Table 2. Forage quality was measured by NIRS at when the average growth stage of the varieties was at boot (March 27) and soft dough (May 8). Forage yield was measured from 2 rows x 18 inches length. The percentage of leaf, stem, and head was determined from 10 plants.

Discussion

Yield and plant characteristics of the varieties are presented in Table 3 and quality is presented in Table 4 for the March 27 sampling (average stage boot) and Table 5 for the May 8 sampling (average stage soft dough). Abbreviations used for the quality parameters are presented in Table 6. Several locations and years are needed to accurately assess variety performance. The results of this trial are most useful when combined with data from previous years. Nevertheless, the results show that winter cereal forage of high yield and quality can be grown in Arizona.

Table 1. Cultural practices for a winter cereal forage trial at the University of Arizona Maricopa Agricultural Center in 2019.

Cultural information	Maricopa Ag Center
Previous crop	Fallow
Soil texture	Sandy loam
Planting date	12/18/18
Precipitation	4.08
Irrigation dates and amounts	12/18: 7.11 in 2/1: 5.10 in 3/1: 2.49 in 3/15: 3.42 in 3/29: 3.55 in 4/12: 4.56 in 4/26: 6.08 in 5/10: 2.79 in TOTAL = 35.1 in
Nitrogen application dates	12/18: 50 lbs N/A as 46-0-0 2/1: 50 lbs N/A as 46-0-0 3/1: 50 lbs N/A as 46-0-0 3/15: 50 lbs N/A as 46-0-0 3/29: 50 lbs N/A as 46-0-0 TOTAL = 250 lbs N/A
Phosphorus application date and amount	12/18: 50 lbs P2O5/a as 0-45-0
Pesticides	None
Sampling dates	Eight

Table 2. Growth stage numeric code.

Numeric code	Growth stage
1	1 leaf
2	2 leaf
3	3 leaf
4	4 leaf
5	5 leaf
6	6 leaf
7	Early jointing
8	Mid jointing
9	Flag leaf visible
10	Flag leaf collar visible
11	Boot
12	Heading
13	Flowering
14	Kernel watery
15	Kernel milky
16	Soft dough
17	Hard dough
18	Physiological maturity
19	Harvest ripe

Table 3. Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
				T/A	%	%	%	inches	%	
30-Jan-19	Triticale	BSI	105	0.8	100	0	0	.	.	4.5
			SY 115T	0.5	100	0	0	.	.	4.6
			SY 158T	0.7	100	0	0	.	.	4.5
			Merlin Max	0.8	100	0	0	.	.	4.4
			Legend	0.6	100	0	0	.	.	4.5
			Swift 77	0.9	100	0	0	.	.	4.7
			Goldrush 91	0.9	100	0	0	.	.	4.6
			SY 158T	0.5	100	0	0	.	.	4.3
		APB	470,113	0.9	100	0	0	.	.	4.4
			470,133	0.3	100	0	0	.	.	4.5
			470,249	0.7	100	0	0	.	.	4.5
			470,269	0.3	100	0	0	.	.	4.6
			470,285	0.6	100	0	0	.	.	4.3
			770,001	0.7	100	0	0	.	.	4.5
			770,113	0.8	100	0	0	.	.	4.6
	Barley	BSI	Chowford	1.0	.	.	.	.	.	.
			Eureka	0.9	.	.	.	.	.	.
			Pronto	0.7	.	.	.	.	.	.
		UA	Solar	0.8	.	.	.	.	.	.
	Triticale	BSI	SY 158T	0.6	.	.	.	.	.	.
	Oats	BSI	UC125	0.4	.	.	.	.	.	.
			UC132	0.5	.	.	.	.	.	.
		APB	Wildcat Oat 60	0.4	.	.	.	.	.	.
			Wildcat Oat 62	0.3	.	.	.	.	.	.
	Wheat	BSI	PR1404	0.5	.	.	.	.	.	.

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
27-Feb-19	Triticale	BSI	105	1	4.5	57	43	0	19	.	7.7
			SY 115T	2	2.9	66	34	0	12	.	7.2
			SY 158T	3	3.6	63	37	0	15	.	7.3
			Merlin Max	4	4.6	66	34	0	15	.	7.3
			Legend	5	3.7	66	34	0	16	.	7.2
			Swift 77	6	5.8	52	48	0	19	.	8.0
			Goldrush 91	7	4.7	58	42	0	16	.	7.8
			SY 158T	8	3.8	61	39	0	15	.	7.3
		APB	470,113	9	4.0	64	36	0	14	.	7.3
			470,133	10	3.0	62	38	0	15	.	7.0
			470,249	11	4.7	61	39	0	15	.	7.3
			470,269	12	3.9	59	41	0	15	.	7.3
			470,285	13	3.7	60	40	0	16	.	7.5
			770,001	14	4.1	57	43	0	18	.	7.8
			770,113	15	3.6	58	42	0	16	.	7.5
	Barley	BSI	Chowford	16	.	.	.	.	.	.	.
			Eureka	17	.	.	.	.	.	.	.
			Pronto	18	.	.	.	.	.	.	.
		UA	Solar	19	.	.	.	.	.	.	.
	Triticale	BSI	SY 158T	20	.	.	.	.	.	.	.
	Oats	BSI	UC125	21	.	.	.	.	.	.	.
			UC132	22	.	.	.	.	.	.	.
		APB	Wildcat Oat 60	23	.	.	.	.	.	.	.
			Wildcat Oat 62	24	.	.	.	.	.	.	.
	Wheat	BSI	PR1404	25	.	.	.	.	.	.	.

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
14-Mar-19	Triticale	BSI	105	1	11.2	51	49	0	32	.	9.3
			SY 115T	2	8.1	53	47	0	23	.	8.7
			SY 158T	3	9.0	53	47	0	25	.	9.1
			Merlin Max	4	8.7	58	42	0	27	.	8.7
			Legend	5	8.5	57	43	0	23	.	8.5
			Swift 77	6	11.1	46	54	0	31	.	10.1
			Goldrush 91	7	11.1	49	51	0	28	.	9.8
			SY 158T	8	7.1	52	48	0	25	.	8.8
		APB	470,113	9	7.4	54	46	0	23	.	8.7
			470,133	10	5.2	55	45	0	22	.	8.9
			470,249	11	10.0	54	46	0	24	.	9.0
			470,269	12	9.6	54	46	0	25	.	9.2
			470,285	13	7.7	50	50	0	28	.	9.1
			770,001	14	9.9	49	51	0	30	.	10.0
			770,113	15	9.2	51	49	0	25	.	9.6
	Barley	BSI	Chowford	16	.	.	.	.	.	.	.
			Eureka	17	.	.	.	.	.	.	.
			Pronto	18	.	.	.	.	.	.	.
		UA	Solar	19	.	.	.	.	.	.	.
	Triticale	BSI	SY 158T	20	.	.	.	.	.	.	.
	Oats	BSI	UC125	21	.	.	.	.	.	.	.
			UC132	22	.	.	.	.	.	.	.
		APB	Wildcat Oat 60	23	.	.	.	.	.	.	.
			Wildcat Oat 62	24	.	.	.	.	.	.	.
	Wheat	BSI	PR1404	25	.	.	.	.	.	.	.

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
27-Mar-19	Triticale	BSI	105	1	14.7	35	65	0	40	.	11.3
			SY 115T	2	10.0	43	57	0	32	.	10.4
			SY 158T	3	14.3	41	59	0	34	.	11.0
			Merlin Max	4	11.9	47	53	0	40	.	10.0
			Legend	5	12.3	54	46	0	30	.	10.0
			Swift 77	6	15.4	27	69	4	41	.	11.5
			Goldrush 91	7	13.5	30	70	0	38	.	11.4
			SY 158T	8	13.2	41	59	0	34	.	11.0
		APB	470,113	9	12.3	54	46	0	32	.	10.0
			470,133	10	10.6	44	56	0	32	.	10.0
			470,249	11	13.6	41	59	0	33	.	10.7
			470,269	12	10.4	41	59	0	35	.	11.0
			470,285	13	12.3	35	65	0	40	.	11.2
			770,001	14	14.2	35	65	1	41	.	11.4
			770,113	15	13.8	36	64	0	38	.	11.0
	Barley	BSI	Chowford	16	17.3	.	.	.	.	.	11.1
			Eureka	17	17.1	.	.	.	.	.	11.0
			Pronto	18	13.7	.	.	.	.	.	11.9
		UA	Solar	19	15.5	.	.	.	.	.	13.0
	Triticale	BSI	SY 158T	20	13.5	.	.	.	.	.	10.9
	Oats	BSI	UC125	21	14.2	.	.	.	.	.	9.0
			UC132	22	13.6	.	.	.	.	.	9.0
		APB	Wildcat Oat 60	23	13.5	.	.	.	.	.	9.0
			Wildcat Oat 62	24	17.0	.	.	.	.	.	9.0
	Wheat	BSI	PR1404	25	15.5	.	.	.	.	.	10.0

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
10-Apr-19	Triticale	BSI	105	1	17.3	26	53	21	49	.	12.0
			SY 115T	2	15.2	30	50	20	38	.	12.2
			SY 158T	3	16.9	29	49	23	39	.	12.1
			Merlin Max	4	15.4	37	63	0	49	.	10.0
			Legend	5	19.2	38	56	6	38	.	11.3
			Swift 77	6	18.1	20	54	25	46	.	12.1
			Goldrush 91	7	19.0	22	51	26	41	.	12.7
			SY 158T	8	16.3	28	50	22	38	.	12.0
		APB	470,113	9	17.0	35	55	10	41	.	11.7
			470,133	10	13.0	29	50	20	37	.	12.0
			470,249	11	17.8	28	50	22	41	.	12.1
			470,269	12	18.0	27	50	23	41	.	12.0
			470,285	13	16.7	25	56	20	49	.	12.1
			770,001	14	15.4	23	55	22	48	.	12.2
			770,113	15	20.2	23	58	19	51	.	12.2
	Barley	BSI	Chowford	16	19.7	.	.	.	.	.	14.3
			Eureka	17	17.8	.	.	.	.	.	12.8
			Pronto	18	22.2	.	.	.	.	.	14.3
		UA	Solar	19	19.0	.	.	.	.	.	16.0
	Triticale	BSI	SY 158T	20	18.5	.	.	.	.	.	12.3
	Oats	BSI	UC125	21	19.2	.	.	.	.	.	9.7
			UC132	22	21.8	.	.	.	.	.	11.0
		APB	Wildcat Oat 60	23	19.7	.	.	.	.	.	9.3
			Wildcat Oat 62	24	16.2	.	.	.	.	.	9.0
	Wheat	BSI	PR1404	25	21.4	.	.	.	.	.	12.3

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
24-Apr-19	Triticale	BSI	105	1	20.1	19	49	33	49	63	14.7
			SY 115T	2	16.8	21	45	34	40	66	13.1
			SY 158T	3	20.6	21	44	35	40	66	13.7
			Merlin Max	4	16.5	26	59	15	48	74	12.4
			Legend	5	20.4	28	49	23	40	68	12.7
			Swift 77	6	23.6	15	42	43	46	58	14.7
			Goldrush 91	7	20.7	16	42	42	40	62	14.5
			SY 158T	8	20.6	22	45	34	40	66	13.8
		APB	470,113	9	19.3	26	48	27	43	66	12.3
			470,133	10	17.5	22	45	34	38	66	13.8
			470,249	11	20.5	21	44	35	40	65	14.4
			470,269	12	19.2	21	45	34	41	65	13.9
			470,285	13	20.2	18	49	33	49	62	13.7
			770,001	14	19.9	18	47	35	48	60	13.8
			770,113	15	26.3	16	50	34	50	63	13.9
	Barley	BSI	Chowford	16	15.2	.	.	.	.	55	17.2
			Eureka	17	21.2	.	.	.	.	46	17.0
			Pronto	18	22.9	.	.	.	.	33	18.0
		UA	Solar	19	23.6	.	.	.	.	42	17.5
	Triticale	BSI	SY 158T	20	22.6	.	.	.	.	66	13.8
	Oats	BSI	UC125	21	20.6	.	.	.	.	72	11.0
			UC132	22	21.1	.	.	.	.	65	12.1
		APB	Wildcat Oat 60	23	22.6	.	.	.	.	77	11.0
			Wildcat Oat 62	24	26.6	.	.	.	.	76	11.0
	Wheat	BSI	PR1404	25	25.4	.	.	.	.	62	14.3

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
8-May-19	Triticale	BSI	105	1	27.7	15	34	51	48	48	16.7
			SY 115T	2	29.1	16	31	53	39	51	16.3
			SY 158T	3	25.4	16	33	51	40	50	16.3
			Merlin Max	4	25.3	23	56	21	51	62	14.3
			Legend	5	28.3	23	41	36	41	53	14.3
			Swift 77	6	28.7	13	34	53	46	43	17.7
			Goldrush 91	7	26.0	15	31	54	41	43	17.5
			SY 158T	8	28.7	17	32	50	40	50	16.2
		APB	470,113	9	26.4	22	35	43	43	55	15.2
			470,133	10	24.6	18	31	50	37	51	16.1
			470,249	11	29.5	18	32	50	39	50	16.4
			470,269	12	31.4	18	32	51	42	51	16.0
			470,285	13	26.9	15	36	49	50	44	17.5
			770,001	14	28.2	16	35	49	48	44	17.0
			770,113	15	28.2	15	37	49	51	46	17.0
	Barley	BSI	Chowford	16	23.4	.	.	.	.	20	18.0
			Eureka	17	20.3	.	.	.	.	18	18.0
			Pronto	18	22.9	.	.	.	.	13	18.0
		UA	Solar	19	19.8	.	.	.	.	15	18.0
	Triticale	BSI	SY 158T	20	30.6	.	.	.	.	51	16.5
	Oats	BSI	UC125	21	17.0	.	.	.	.	61	15.0
			UC132	22	25.3	.	.	.	.	43	17.5
		APB	Wildcat Oat 60	23	20.1	.	.	.	.	66	15.0
			Wildcat Oat 62	24	22.4	.	.	.	.	65	14.5
	Wheat	BSI	PR1404	25	29.2	.	.	.	.	46	16.7

Table 3 (con'd). Forage yield (at 72% moisture) and other characteristics of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019.

Date	Crop	Source	Entry	Variety	Forage yield	Leaf	Stem	Head	Plant height	Head moisture	Growth stage
					T/A	%	%	%	inches	%	
23-May-19	Triticale	BSI	105	1	22.7	15	33	53	48	11	19.0
			SY 115T	2	25.8	15	27	58	39	16	19.0
			SY 158T	3	27.0	16	28	56	40	23	18.3
			Merlin Max	4	26.0	18	54	28	51	50	17.0
			Legend	5	26.3	20	36	44	41	39	17.8
			Swift 77	6	24.6	12	31	57	47	10	19.0
			Goldrush 91	7	24.9	14	30	56	41	12	19.0
			SY 158T	8	27.4	15	29	56	40	20	18.5
		APB	470,113	9	28.3	16	30	55	41	37	17.8
			470,133	10	27.1	15	28	57	39	22	18.5
			470,249	11	29.2	16	26	58	41	18	18.7
			470,269	12	23.7	13	28	58	41	17	18.9
			470,285	13	23.7	12	35	53	50	11	19.0
			770,001	14	25.8	13	34	53	48	11	19.0
			770,113	15	26.9	11	36	53	53	12	19.0
	Barley	BSI	Chowford	16	21.0	.	.	.	.	14	18.7
			Eureka	17	19.3	.	.	.	.	13	18.8
			Pronto	18	20.0	.	.	.	.	12	18.6
		UA	Solar	19	18.8	.	.	.	.	16	18.8
	Triticale	BSI	SY 158T	20	29.0	.	.	.	.	24	18.5
	Oats	BSI	UC125	21	30.5	.	.	.	.	44	17.7
			UC132	22	26.8	.	.	.	.	16	18.0
		APB	Wildcat Oat 60	23	32.0	.	.	.	.	38	17.7
			Wildcat Oat 62	24	32.1	.	.	.	.	47	17.5
	Wheat	BSI	PR1404	25	27.1	.	.	.	.	12	19.0

Table 4a. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is March 27 when the average growth stage was boot. See Table 6 for quality parameter abbreviations.

Crop	Entry	DM	Moist	Ash	NDF	ADF	CP	RFV	TDN	RFQ	NEL	Fat
		%	%	%	%	%	%		%		Mcal/lb DM	%
Triticale	105	93.9	6.13	8.95	58.8	39.1	20.4	92.5	53.0	88.0	0.54	2.01
	SY 115T	93.1	6.87	8.76	54.5	37.0	22.8	102.5	54.6	98.0	0.55	2.10
	SY 158T	93.9	6.07	9.15	57.4	38.1	21.7	96.0	53.7	91.5	0.54	2.02
	Merlin Max	94.5	5.56	9.15	60.0	39.4	21.5	90.5	52.8	86.0	0.53	2.06
	Legend	92.9	7.09	8.84	54.1	36.5	23.0	104.0	55.0	99.0	0.56	2.14
	Swift 77	94.7	5.34	9.09	61.3	39.8	18.2	88.0	52.5	83.5	0.53	1.99
	Goldrush 91	94.4	5.60	9.12	58.9	39.3	19.1	92.0	52.9	87.5	0.53	1.99
	SY 158T	93.6	6.37	9.19	57.0	38.0	22.0	96.5	53.8	92.0	0.55	2.03
	470,113	93.7	6.35	9.04	56.3	37.2	22.1	99.0	54.4	94.5	0.55	2.11
	470,133	93.3	6.66	8.98	54.9	36.6	22.7	102.0	54.9	97.5	0.56	2.12
	470,249	93.7	6.35	9.14	57.5	38.6	20.5	95.5	53.4	90.5	0.54	2.01
	470,269	93.6	6.43	9.07	55.6	36.7	22.9	101.0	54.8	96.0	0.56	2.03
	470,285	93.9	6.09	9.02	57.6	38.0	21.0	96.0	53.8	91.0	0.54	2.02
	770,001	94.8	5.26	9.18	61.1	40.4	19.0	87.5	52.0	83.0	0.53	1.98
770,113	94.4	5.65	9.01	58.6	38.7	21.1	93.5	53.3	88.5	0.54	2.06	
Barley	Chowford	94.6	5.40	9.21	61.4	39.7	18.6	88.0	52.6	83.5	0.53	1.93
	Eureka	94.6	5.36	9.37	60.7	39.8	18.5	89.0	52.5	84.5	0.53	1.88
	Pronto	94.6	5.36	9.28	59.8	37.5	21.4	92.5	54.2	88.5	0.55	1.98
	Solar	94.9	5.09	9.62	60.8	38.4	16.0	90.0	53.5	86.0	0.54	1.92
Triticale	SY 158T	93.7	6.31	8.97	57.2	37.8	22.0	97.0	54.0	92.0	0.55	2.10
Oats	UC125	94.1	5.95	9.10	59.1	37.6	22.3	94.0	54.1	89.0	0.55	1.98
	UC132	94.1	5.92	9.17	58.9	38.0	20.9	94.0	53.8	89.0	0.54	2.01
	Wildcat Oat 60	94.3	5.69	8.90	59.5	37.7	21.5	93.0	54.1	88.5	0.55	2.10
	Wildcat Oat 62	94.1	5.89	9.10	58.8	37.1	22.5	95.0	54.5	90.5	0.56	1.97
Wheat	PR1404	93.4	6.61	8.87	56.0	35.9	23.7	101.5	55.4	96.5	0.57	2.11

Table 4b. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is March 27 when the average growth stage was boot. See Table 6 for quality parameter abbreviations.

Crop	Entry	Ca	K	Mg	S	K	Na	Cl	Fe	Mn	Cu	Zn
		%	%	%	%	%	%	%	ppm	ppm	ppm	ppm
Triticale	105	0.31	0.39	0.26	0.24	4.21	0.01	1.03	233	92.5	9.9	48.4
	SY 115T	0.31	0.41	0.27	0.25	4.41	0.01	0.97	191	90.8	9.5	49.5
	SY 158T	0.31	0.41	0.27	0.25	4.19	0.01	1.04	235	86.4	10.7	49.4
	Merlin Max	0.31	0.44	0.25	0.24	4.56	0.01	1.09	250	93.5	11.7	48.3
	Legend	0.31	0.40	0.26	0.26	4.54	0.01	1.08	229	93.2	10.0	48.7
	Swift 77	0.31	0.35	0.25	0.24	3.97	0.01	1.04	241	65.9	9.4	47.6
	Goldrush 91	0.31	0.38	0.26	0.24	3.97	0.01	1.09	224	73.8	9.8	48.5
	SY 158T	0.31	0.41	0.27	0.25	4.19	0.01	1.03	235	87.1	10.5	49.2
	470,113	0.31	0.42	0.26	0.26	4.44	0.01	1.04	245	71.5	11.0	48.9
	470,133	0.31	0.40	0.27	0.26	4.28	0.01	1.01	202	87.4	10.3	48.6
	470,249	0.31	0.39	0.26	0.24	4.20	0.01	1.04	222	88.1	10.3	49.1
	470,269	0.31	0.39	0.26	0.26	4.23	0.01	1.04	203	91.0	9.8	48.8
	470,285	0.31	0.37	0.25	0.27	4.07	0.01	1.03	232	68.1	8.5	48.6
	770,001	0.31	0.40	0.26	0.25	4.18	0.01	1.08	243	85.5	11.4	47.4
	770,113	0.31	0.42	0.26	0.25	4.34	0.01	1.05	244	76.1	11.3	48.6
Barley	Chowford	0.31	0.41	0.27	0.23	4.16	0.01	1.08	200	98.5	9.7	46.6
	Eureka	0.31	0.38	0.25	0.23	4.26	0.01	1.09	204	85.5	10.0	46.3
	Pronto	0.31	0.40	0.26	0.24	4.15	0.01	1.06	227	95.6	10.2	46.9
	Solar	0.31	0.31	0.24	0.22	3.56	0.01	1.13	157	83.3	6.5	44.6
Triticale	SY 158T	0.31	0.41	0.27	0.25	4.25	0.01	1.01	234	80.9	10.2	49.2
Oats	UC125	0.31	0.44	0.27	0.24	4.29	0.01	1.06	142	92.3	9.7	49.8
	UC132	0.31	0.38	0.25	0.26	4.12	0.01	1.04	139	75.0	7.2	48.8
	Wildcat Oat 60	0.31	0.45	0.28	0.24	4.37	0.01	1.00	185	88.9	9.5	49.4
	Wildcat Oat 62	0.31	0.44	0.28	0.24	4.14	0.01	1.08	224	88.5	9.6	49.8
Wheat	PR1404	0.31	0.40	0.26	0.28	4.48	0.01	1.01	232	78.9	10.6	48.6

Table 4c. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is March 27 when the average growth stage was boot. See Table 6 for quality parameter abbreviations.

Crop	Entry	SP	ADF-CP	NDF-CP	UIP	Lignin	Starch	NFC	Carbo	Sugar
		%	%	%	% of CP	%	%	%	%	%
Triticale	105	43.6	1.08	2.71	30.5	7.29	5.23	17.9	5.81	3.56
	SY 115T	46.2	1.08	2.59	27.6	6.87	3.80	18.3	7.18	4.98
	SY 158T	42.9	1.14	2.68	30.2	7.03	4.69	19.5	5.95	4.74
	Merlin Max	41.0	1.17	2.84	32.1	7.26	5.78	18.0	4.47	3.07
	Legend	46.1	1.13	2.72	28.4	6.86	3.87	19.9	6.71	5.33
	Swift 77	43.8	0.99	2.41	30.8	7.34	6.90	18.2	5.08	2.45
	Goldrush 91	43.3	1.02	2.61	30.3	7.13	6.59	17.8	5.56	4.21
	SY 158T	43.0	1.15	2.67	30.3	6.99	5.01	20.4	6.44	4.47
	470,113	43.9	1.13	2.68	29.9	6.74	4.98	19.0	5.52	5.14
	470,133	44.6	1.14	2.69	28.9	6.78	3.27	19.2	7.00	5.54
	470,249	43.1	1.12	2.58	30.5	7.12	5.73	20.9	6.05	4.18
	470,269	44.0	1.09	2.72	29.3	7.02	2.36	20.0	7.39	5.27
	470,285	45.9	1.06	2.46	29.4	7.16	3.01	17.9	6.23	4.08
Barley	770,001	40.8	1.09	2.75	31.9	7.35	8.09	18.9	4.70	3.33
	770,113	42.7	1.09	2.67	30.5	7.03	5.33	18.8	4.87	3.98
	Chowford	39.8	1.00	2.69	32.1	6.62	5.56	18.8	5.03	4.57
Triticale	Eureka	41.4	1.04	2.61	31.3	7.02	6.79	19.7	5.67	4.12
	Pronto	41.5	1.04	2.76	31.8	6.98	3.83	18.9	5.95	4.34
	Solar	43.8	1.03	2.36	32.7	7.42	6.29	21.1	6.77	4.83
	SY 158T	43.1	1.15	2.73	29.9	7.22	3.14	19.6	6.13	4.57
Oats	UC125	42.8	1.02	2.63	29.9	6.40	1.11	19.2	5.93	6.15
	UC132	44.2	1.02	2.50	29.0	7.10	3.16	19.3	6.34	3.69
	Wildcat Oat 60	42.0	1.09	2.65	30.5	5.90	4.01	19.4	5.41	5.21
	Wildcat Oat 62	41.8	1.06	2.73	30.8	5.95	4.86	21.4	5.69	4.82
	PR1404	44.8	1.05	2.66	28.7	6.94	3.64	19.2	6.97	4.76

Table 4d. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is March 27 when the average growth stage was boot. See Table 6 for quality parameter abbreviations..

Crop	Entry	IVTDMD24	IVTDMD30	IVTDMD48	NDFD24	NDFD30	NDFD48	Lys	Met	AA	LA
		%	%	%	% of NDF	% of NDF	% of NDF	%	%	%	%
Triticale	105	61.2	66.7	75.8	37.4	53.1	64.4	0.44	0.17	1.84	2.40
	SY 115T	61.7	67.8	78.9	35.6	55.9	67.8	0.54	0.20	1.95	2.17
	SY 158T	61.2	67.7	78.4	36.8	54.8	64.9	0.48	0.18	1.96	2.52
	Merlin Max	59.3	66.5	76.8	38.1	57.7	68.0	0.43	0.17	1.86	1.50
	Legend	62.8	69.2	80.9	37.4	55.4	68.1	0.53	0.21	2.07	2.85
	Swift 77	60.3	65.9	74.6	32.0	49.0	61.9	0.43	0.17	1.96	2.38
	Goldrush 91	61.8	68.0	77.5	37.2	52.2	63.8	0.43	0.17	1.85	2.39
	SY 158T	62.2	68.5	78.2	37.9	54.7	65.2	0.49	0.19	1.97	2.62
	470,113	61.2	67.7	78.9	36.3	56.7	67.0	0.50	0.20	1.94	2.39
	470,133	61.6	68.1	81.0	37.0	55.5	66.9	0.53	0.20	1.98	2.47
	470,249	62.4	68.4	78.0	38.3	54.0	65.3	0.46	0.18	1.78	2.55
	470,269	62.8	69.0	79.8	39.1	54.1	67.1	0.51	0.20	2.11	2.88
	470,285	61.0	67.4	78.4	34.5	51.5	64.6	0.51	0.19	1.94	2.63
Triticale	770,001	61.1	67.8	74.7	36.7	53.5	64.2	0.38	0.15	1.81	1.80
	770,113	60.3	66.8	77.9	37.2	54.5	65.8	0.46	0.18	1.97	2.04
Barley	Chowford	58.7	64.9	73.8	35.7	52.9	63.3	0.39	0.16	1.54	1.81
	Eureka	59.9	66.0	74.7	34.8	50.5	63.5	0.43	0.18	1.56	2.00
	Pronto	59.1	64.7	76.3	35.6	51.9	63.1	0.48	0.19	1.80	2.14
	Solar	58.1	63.9	75.9	34.1	46.1	60.6	0.41	0.16	1.40	2.26
Triticale	SY 158T	60.1	66.7	79.2	34.8	55.0	65.5	0.50	0.19	1.84	2.40
Oats	UC125	61.1	67.8	76.6	39.6	56.5	66.6	0.50	0.20	1.73	2.59
	UC132	63.9	70.1	74.3	38.7	51.7	65.2	0.51	0.19	1.78	2.65
	Wildcat Oat 60	59.6	66.4	76.0	38.5	59.3	69.3	0.52	0.20	1.51	1.88
	Wildcat Oat 62	62.2	69.1	75.9	41.7	57.7	66.8	0.49	0.20	1.73	1.94
Wheat	PR1404	63.5	69.7	77.8	38.3	55.4	67.4	0.52	0.20	2.19	2.77

Table 5a. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is May 8 when the average growth stage was soft dough. See Table 6 for quality parameter abbreviations.

Crop	Entry	DM	Moist	Ash	NDF	ADF	CP	RFV	TDN	RFQ	NEL	Fat
		%	%	%	%	%	%		%		Mcal/lb DM	%
Triticale	105	94.6	5.37	9.72	60.2	37.6	8.6	92.0	54.1	88.0	0.55	2.02
	SY 115T	94.6	5.45	9.69	58.6	36.5	9.7	96.5	55.0	91.5	0.56	2.01
	SY 158T	94.5	5.55	9.58	60.0	36.7	10.8	93.5	54.8	89.0	0.56	2.09
	Merlin Max	94.7	5.31	9.65	61.9	38.7	12.3	88.5	53.3	84.0	0.54	1.90
	Legend	94.6	5.43	9.58	58.9	36.9	11.0	95.0	54.7	90.5	0.55	2.04
	Swift 77	94.0	6.02	9.85	59.3	36.0	8.0	95.5	55.4	91.0	0.56	2.05
	Goldrush 91	94.8	5.18	9.65	60.9	37.4	8.8	91.5	54.3	87.0	0.55	2.07
	SY 158T	94.3	5.67	9.56	60.6	37.0	10.9	92.0	54.6	88.0	0.55	2.10
	470,113	94.7	5.34	9.50	61.1	37.3	11.1	91.0	54.4	87.0	0.55	2.02
	470,133	94.5	5.56	9.64	59.5	36.6	10.8	94.5	54.9	90.0	0.56	2.07
	470,249	94.2	5.78	9.51	60.3	36.7	10.3	93.0	54.8	88.5	0.56	2.07
	470,269	94.1	5.88	9.62	58.5	36.3	9.6	96.5	55.1	91.5	0.56	2.07
	470,285	94.9	5.08	9.82	59.7	37.1	8.5	93.5	54.5	89.0	0.55	2.00
	770,001	94.8	5.21	9.61	61.8	38.5	9.0	89.0	53.5	84.5	0.54	2.07
	770,113	94.6	5.36	9.86	60.8	37.4	10.2	91.0	54.3	87.0	0.55	2.04
Barley	Chowford	94.7	5.34	9.60	63.9	41.8	7.9	82.5	51.0	78.5	0.52	1.72
	Eureka	94.1	5.87	9.69	60.1	39.1	9.8	90.5	53.0	86.0	0.54	1.94
	Pronto	92.9	7.07	10.02	53.4	35.0	9.0	107.0	56.1	102.0	0.57	1.91
	Solar	94.6	5.42	9.82	60.8	38.6	8.0	90.0	53.4	85.5	0.54	1.97
Triticale	SY 158T	94.6	5.46	9.65	60.8	38.1	11.8	91.0	53.8	86.5	0.55	2.02
Oats	UC125	95.1	4.91	9.40	67.4	44.1	10.7	75.5	49.2	71.0	0.49	1.89
	UC132	94.3	5.76	9.82	57.7	36.8	9.4	97.5	54.7	92.5	0.55	2.00
	Wildcat Oat 60	94.8	5.22	9.26	66.3	45.4	13.5	75.5	48.3	71.0	0.48	1.97
	Wildcat Oat 62	94.9	5.09	9.19	67.7	51.1	15.3	67.5	44.0	63.5	0.43	2.10
Wheat	PR1404	94.2	5.84	9.63	60.0	37.2	10.2	93.0	54.4	88.5	0.56	2.08

Table 5b. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is May 8 when the average growth stage was soft dough. See Table 6 for quality parameter abbreviations.

Crop	Entry	Ca	K	Mg	S	K	Na	Cl	Fe	Mn	Cu	Zn
		%	%	%	%	%	%	%	ppm	ppm	ppm	ppm
Triticale	105	0.30	0.26	0.26	0.23	2.75	0.01	1.15	241	51.4	7.1	44.1
	SY 115T	0.31	0.27	0.26	0.23	2.88	0.01	1.17	223	69.1	7.2	44.2
	SY 158T	0.31	0.28	0.27	0.23	3.03	0.01	1.11	244	62.5	8.7	44.0
	Merlin Max	0.31	0.29	0.25	0.24	3.03	0.01	1.13	220	38.5	6.7	44.5
	Legend	0.31	0.28	0.28	0.24	2.96	0.01	1.16	222	83.8	7.8	44.7
	Swift 77	0.31	0.23	0.26	0.21	2.81	0.01	1.06	221	91.8	7.7	43.0
	Goldrush 91	0.30	0.26	0.26	0.22	2.91	0.01	1.09	228	84.7	8.1	43.9
	SY 158T	0.31	0.29	0.27	0.24	3.05	0.01	1.10	239	60.0	9.1	44.4
	470,113	0.31	0.30	0.27	0.24	3.05	0.01	1.13	239	63.8	8.3	44.9
	470,133	0.31	0.27	0.27	0.24	2.89	0.01	1.10	241	56.5	8.3	44.4
	470,249	0.31	0.28	0.27	0.23	2.94	0.01	1.10	238	71.7	8.7	44.0
	470,269	0.31	0.27	0.26	0.23	2.91	0.01	1.10	233	79.4	7.7	44.1
	470,285	0.30	0.23	0.25	0.22	2.67	0.01	1.11	234	56.5	5.9	44.0
	770,001	0.31	0.28	0.25	0.21	3.12	0.01	1.06	230	70.9	9.9	43.8
	770,113	0.31	0.25	0.24	0.20	2.98	0.01	1.03	238	63.6	7.6	43.6
Barley	Chowford	0.32	0.29	0.29	0.23	3.41	0.01	1.15	188	118.7	5.7	43.5
	Eureka	0.31	0.29	0.27	0.21	3.39	0.01	1.31	169	59.7	6.5	43.4
	Pronto	0.31	0.27	0.29	0.22	2.92	0.01	1.57	137	115.7	5.8	45.0
	Solar	0.31	0.27	0.26	0.20	2.90	0.01	1.21	189	92.4	6.7	42.0
Triticale	SY 158T	0.31	0.28	0.26	0.23	3.22	0.01	1.09	236	64.8	7.3	44.1
Oats	UC125	0.31	0.34	0.27	0.22	3.91	0.01	1.13	232	118.9	5.7	43.2
	UC132	0.31	0.27	0.25	0.23	2.98	0.01	1.14	185	56.4	6.0	44.0
	Wildcat Oat 60	0.31	0.32	0.27	0.23	3.99	0.01	1.16	248	108.4	7.8	44.0
	Wildcat Oat 62	0.30	0.31	0.28	0.23	4.30	0.01	1.26	255	121.6	7.2	42.8
Wheat	PR1404	0.31	0.26	0.25	0.22	3.09	0.01	1.03	236	46.3	8.8	43.9

Table 5c. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is May 8 when the average growth stage was soft dough. See Table 6 for quality parameter abbreviations.

Crop	Entry	SP	ADF-CP	NDF-CP	UIP	Lignin	Starch	NFC	Carbo	Sugar	
		%	%	%	% of CP	%	%	%	%	%	
Triticale	105	42.4	0.87	1.94	32.7	7.34	10.58	24.2	6.56	3.80	
	SY 115T	42.1	0.87	2.08	32.1	7.20	10.03	25.0	6.55	3.85	
	SY 158T	41.3	0.88	2.14	32.4	7.28	9.70	25.0	5.81	2.76	
	Merlin Max	44.3	0.97	2.15	32.7	7.86	7.69	22.2	6.84	4.76	
	Legend	43.1	0.88	2.15	31.8	7.05	9.69	22.7	7.09	4.34	
	Swift 77	39.0	0.86	2.07	33.4	7.18	11.31	26.2	6.20	3.08	
	Goldrush 91	39.7	0.85	2.01	33.0	7.18	10.66	23.8	5.36	2.90	
	SY 158T	41.5	0.90	2.06	31.8	7.29	9.69	25.2	5.42	2.47	
	470,113	41.3	0.89	2.08	31.8	7.23	9.94	23.8	5.27	3.40	
	470,133	41.9	0.88	2.08	32.2	7.21	9.94	25.8	6.30	2.96	
	470,249	41.1	0.89	2.04	32.1	7.24	10.12	25.2	5.57	2.51	
	470,269	41.7	0.89	2.00	32.1	7.12	11.67	26.7	6.65	3.11	
	470,285	42.8	0.87	1.90	32.4	7.56	10.90	25.3	6.40	3.82	
	770,001	40.5	0.88	1.90	32.9	7.27	10.10	23.7	5.20	2.98	
	770,113	40.3	0.88	2.03	33.6	7.50	9.59	23.9	5.17	3.12	
	Barley	Chowford	38.5	0.86	2.30	40.2	5.99	6.91	17.5	7.19	3.84
		Eureka	43.4	0.94	2.20	32.7	6.63	10.06	23.0	7.46	5.57
		Pronto	44.9	0.87	2.13	31.8	5.74	8.39	26.0	12.37	9.34
Solar		39.9	0.94	2.09	36.5	6.74	9.55	23.3	7.22	5.14	
Triticale	SY 158T	39.9	0.91	2.17	34.3	7.24	7.64	21.9	5.38	2.58	
Oats	UC125	32.9	0.98	2.36	43.1	7.10	4.97	13.8	1.75	1.07	
	UC132	42.2	0.93	1.79	31.8	7.19	12.32	28.1	7.19	3.00	
	Wildcat Oat 60	34.4	1.11	2.74	44.5	7.15	4.11	12.4	2.59	1.20	
	Wildcat Oat 62	31.6	1.21	2.98	48.1	7.25	4.99	10.6	2.86	0.52	
Wheat	PR1404	42.6	0.88	2.00	31.3	7.27	10.73	26.1	6.47	2.72	

Table 5d. Forage quality of a winter cereal forage variety trial at the Maricopa Agricultural Center, 2019. The sample date is May 8 when the average growth stage was soft dough. See Table 6 for quality parameter abbreviations.

Crop	Entry	IVTDMD24	IVTDMD30	IVTDMD48	NDFD24	NDFD30	NDFD48	Lys	Met	AA	LA
		%	%	%	% of NDF	% of NDF	% of NDF	%	%	%	%
Triticale	105	58.2	63.8	79.0	34.4	46.0	58.2	0.26	0.12	1.42	2.01
	SY 115T	59.5	65.1	77.1	35.1	46.1	57.9	0.31	0.13	1.61	2.14
	SY 158T	59.3	65.5	76.1	32.7	46.5	57.8	0.31	0.14	1.75	1.99
	Merlin Max	59.6	65.0	81.7	35.4	46.3	58.9	0.35	0.14	1.42	2.15
	Legend	62.4	67.3	79.7	36.8	48.5	59.3	0.33	0.14	1.69	2.30
	Swift 77	58.7	63.9	72.8	35.3	45.5	58.1	0.23	0.11	1.49	1.86
	Goldrush 91	58.0	63.7	73.0	33.8	46.4	57.9	0.24	0.12	1.58	1.89
	SY 158T	58.8	65.0	75.9	32.6	46.7	58.0	0.31	0.14	1.80	2.13
	470,113	58.8	64.7	76.6	33.9	47.7	58.8	0.33	0.14	1.76	2.13
	470,133	59.0	66.0	77.3	33.3	46.7	58.2	0.31	0.13	1.67	2.07
	470,249	59.1	66.6	75.3	33.9	46.4	58.2	0.30	0.13	1.74	2.08
	470,269	59.9	65.4	76.3	34.8	46.5	59.0	0.29	0.13	1.59	2.28
	470,285	58.0	63.7	76.5	34.9	44.8	58.2	0.28	0.12	1.45	1.98
Barley	770,001	56.2	61.7	73.6	32.6	45.7	58.2	0.23	0.11	1.50	1.94
	770,113	56.1	62.9	76.1	32.6	44.0	56.5	0.27	0.13	1.51	1.80
	Chowford	55.5	62.3	72.0	35.5	49.7	56.5	0.23	0.12	0.69	1.22
	Eureka	61.3	66.8	79.2	39.1	47.6	59.7	0.29	0.13	1.10	1.94
Triticale	Pronto	65.9	71.5	81.9	41.8	53.5	63.1	0.31	0.13	1.23	2.30
	Solar	59.3	65.1	76.1	37.5	44.5	56.8	0.24	0.12	1.00	1.86
	SY 158T	57.2	63.5	74.2	31.9	46.6	57.1	0.30	0.14	1.66	1.76
	UC125	53.2	60.6	60.8	33.1	47.2	54.0	0.22	0.12	1.23	0.47
Oats	UC132	60.4	65.9	77.5	36.0	44.9	60.1	0.36	0.15	1.46	2.00
	Wildcat Oat 60	54.6	61.7	62.5	32.8	45.4	52.7	0.27	0.13	0.88	0.60
	Wildcat Oat 62	48.9	57.0	57.8	30.3	45.6	50.7	0.23	0.13	0.18	1.25
Wheat	PR1404	57.7	63.4	76.2	32.7	46.6	59.8	0.28	0.13	1.70	2.15

Table 6. Abbreviations used for forage quality parameters.

Abbreviation	Parameter	Abbreviation	Parameter
DM	DM	SP	Soluble Protein
Moist	Moisture	ADF-CP	ADF CP
Ash	Ash	NDF-CP	NDF CP
NDF	NDF	UIP	UIP
ADF	ADF	Lignin	Lignin
CP	Crude Protein	Starch	Starch
RFV	RFV	NFC	NFC
TDN	TDN	Carbo	Soluble Carbohydrate
RFQ	RFQ	Sugar	Simple Sugar
NEL	NEL	IVTDMD24	IVTDMD24
Fat	Fat	IVTDMD30	IVTDMD30
Ca	Calcium	IVTDMD48	IVTDMD48
K	Phosphorus	NDFD24	NDFD 24
Mg	Magnesium	NDFD30	NDFD 30
S	Sulfur	NDFD48	NDFD 48
K	Potassium	Lys	Lysine
Na	Sodium	Met	Methionine
Cl	Chloride	AA	Acetic Acid
Fe	Iron (ppm)	LA	Lactic Acid
Mn	Manganese (ppm)		
Cu	Copper (ppm)		
Zn	Zinc (ppm)		



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