AGRONOMIC AND SILAGE QUALITY TRAITS OF WINTER CEREALS

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Summary

Agronomic and silage quality traits were examined for 12 winter cereals harvested at two stages of maturity. Forage dry matter (DM) yields were higher at the mid-dough than the early-heading stage. Post 90 barley had the highest whole-plant DM yield at the early-heading stage, and Presto triticale had the highest yield at the mid-dough stage. Newton wheat had the lowest whole-plant DM yield at both stages of maturity. The first cutting of all varieties originally was intended to be at the late-boot stage, but harvest was delayed by frequent rainfall and wet soils in May, and field-wilting conditions were less than ideal. The range in heads emerged was 23 to 87%, and the range in the silage DM content at early-heading stage was 19.2 to 46.4%. Both crude protein (CP) and ash contents were higher for the early-heading cereals than the mid-dough. All 24 silages were of relatively low forage quality, as evidenced by high neutral detergent fiber (NDF) and acid detergent fiber (ADF) percentages. Only five silages, the early-heading stage Tomahawk wheat; mid-dough stage Presto triticale; and the mid-dough stage Kanby, Post, and Post 90 barleys, had less than 60% NDF and 40% ADF. Extensive lodging occurred in virtually all cereals before the mid-dough stage harvest.

(Key Words: Winter Cereals, Silage, Winter Cereal Variety, Winter Cereal Maturity, Winter Cereal Yield.)

Introduction

Although winter cereals generally are planted for grain, they also are used as forage (i.e., pasture, hay, or silage) by many livestock producers in Kansas. Small grain cereals are harvested as forage for several reasons: 1) land can be double-cropped; 2) the risk of crop loss from rain, wind, or hail is decreased; and 3) circumstances sometimes make it desirable, even necessary, to use these crops for forage even though they were planted for another purpose, i.e., weather-stressed wheat with a low level of grain production might be more profitable if harvested as forage. Earlier studies in the 1970's and 1980's (KAES Bulletin 613R and KAES Report of Progress 539, page 190) have shown that stage of maturity and variety have large impacts on both agronomic and silage quality traits of winter cereals.

Our objective was to document agronomic performance and silage quality traits of several of the leading winter cereal varieties currently grown in Kansas.

Experimental Procedures

Twelve winter cereals were planted on October 11, 1994, and grown under dryland conditions near the Kansas State University campus in a Reading silt loam soil. The winter cereals included eight wheat varieties (Karl 92, Tam 107, 2163, Tomahawk, Jagger, 2137, Newton, and Arkan); three barley varieties (Kanby, Post, and Post 90); and one triticale (Presto). Only Arkan and Kanby were included in the most recent winter cereal forage studies (KAES Report of Progress 539). The winter cereals were planted in a randomized complete block design with three replicate plots for each variety. Single plots were 18 ft wide and 30 ft long. Anhydrous ammonia was applied at 80 lb of nitrogen per acre, and the seeding rate was 75 lb per acre for all varieties.

The winter cereals were harvested at the early-heading and mid-dough stages of maturity.

Shortly before each harvest, the ends of the plots were trimmed to remove border effects. Agronomic data collected included plant height, whole-plant dry matter (DM), whole-plant DM yield, and percent head emergence for the early-heading stage. Four drill rows 18 ft in length were harvested from each plot leaving a 4-inch stubble height. The early-heading stage harvest was between May 15 and 19, and the mid-dough stage harvest was between June 12 and 19. The early-heading stage cereals were cut with a sickle-bar mower and field-wilted for 48 hr before being chopped with a FieldQueen forage harvester. Because of the wet soil conditions and severe lodging during the mid-dough stage harvest, the four drill rows from each plot were hand cut with a serrated knife and chopped immediately with the FieldQueen harvester.

Chopped material from each plot was ensiled in a 4   12 inch PVC laboratory-scale silo and packed to similar densities using a hydraulic press. Silos were opened after a 90-day storage period. The fresh-cut and pre-ensiled forages from all plots were analyzed for DM content. All silages were analyzed for pH and DM, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and ash contents.

Results and Discussion

Agronomic performance of the 12 winter cereals harvested at two stages of maturity is presented in Table 1. The effect of stage of maturity at harvest on whole-plant DM content, DM yield, and silage quality traits is shown in Table 2. Whole-plant DM content and DM yield were higher at the mid-dough stage than the early-heading stage. Post 90 barley had the highest whole-plant DM yield at the early-heading stage, and Presto triticale had the highest yield at the mid-dough stage. Newton wheat had the lowest whole-plant DM yield at both stages of maturity. The fresh cut, early-heading forages had an average DM content of 18.2%, with a range of 15.2 to 21.1%, whereas the mid-dough forages averaged 36.7% DM, with a range of 33.5 to 44.9%. Plant heights were similar at the early-heading stage, but Presto triticale was taller than all eight wheat varieties at the mid-dough stage.

Silage quality traits of the 12 winter cereals are presented in Table 3. All mid-dough silages were satisfactorily preserved, as evidenced by a pH range of 4.0 to 4.4. Frequent rain and high humidity occurred during the 48 hr field-wilting period for the early-heading forages. Seven of the 12 early-heading silages had DM contents below 30% and pH values at or above 5.0. Several of these silages had undergone secondary fermentations, which were characterized by the presence of butyric acid and ammonia. Crude protein and ash contents were higher for the early-heading cereals than the mid-dough. All 24 silages were of relatively low forage quality, as evidenced by high NDF and ADF percentages. Only five silages, the early-heading stage Tomahawk wheat; mid-dough stage Presto triticale; and the mid-dough stage Kanby, Post, and Post 90 barleys, had less than 60% NDF and 40% ADF contents.

Table 1. Agronomic Performance of the 12 Winter Cereals Harvested at Two Stages of Maturity

	Early-Heading Stage			Mid-Dough Stage		
Winter Cereal and Variety[1]	Whole-Plant DM	Plant Height	Whole-Plant DM yield	Whole-Plant DM	Plant Height	Whole-Plant DM yield
Wheat	%	inches	tons/acre	%	inches	tons/acre
Karl 92 (81)	19.6	35	3.9	37.7	36	4.9
Tam 107 (87)	19.8	37	3.7	44.9	37	5.0
2163 (43)	18.3	37	3.9	33.5	36	4.7
Tomahawk (28)	19.0	35	3.0	37.8	35	4.4
Jagger (57)	19.3	36	4.0	36.2	36	4.7
2137 (34)	17.1	36	3.3	40.8	37	4.7
Newton (23)	19.4	38	2.9	34.8	37	3.9
Arkan (45)	21.1	38	3.7	34.3	37	4.3
Barley						
Kanby (34)	17.8	40	3.8	40.8	41	4.5
Post (43)	15.2	38	3.7	35.3	39	4.4
Post 90 (24)	16.0	38	4.2	30.2	37	4.3
Triticale						
Presto (63)	15.3	40	3.8	33.9	43	5.3
Average (47)	18.2	37	3.7	36.7	38	4.6
LSD (P<.05)[2]	1.7	6	.5	9.9	5	.4

[1]Percent heads emerged from the flag leaf at the early-heading stage cutting is shown in parentheses.
[2]The LSD (least significant difference) is valid only within a column.

Table 2. Effect of Stage of Maturity at Harvest on Whole-Plant DM Content, DM Yield, and Silage Quality Traits[1]

	Whole-Plant		Silage					
Stage of Maturity	DM	DM Yield	pH	DM	CP	NDF	ADF	Ash
	%	tons/acre		%	% of the silage DM			
Early-heading	18.2	3.7	5.3	29.3	13.5	61.5	41.3	13.2
Mid-dough	36.7	4.6	4.2	35.4	11.7	60.2	40.6	10.2
LSD (P<.05)[2]	1.9	.1	.2	2.1	.4	1.4	2.4	.5

[1]CP = crude protein; NDF = neutral detergent fiber; and ADF = acid detergent fiber.
[2]The LSD (least significant difference) is valid only within a column.

Table 3. Silage Quality Traits of the 12 Winter Cereals Harvested at Two Stages of Maturity [1]

Winter Cereal	Early-Heading Stage						Mid-Dough Stage					
and Variety	pH	DM	CP	NDF	ADF	Ash	pH	DM	CP	NDF	ADF	Ash
Wheat		%	——% of the silage DM——					%	——% of the silage DM——			
Karl 92	4.7	31.9	12.8	60.3	40.9	13.3	4.0	36.7	10.4	60.0	40.1	9.3
Tam 107	5.3	28.0	13.4	63.2	42.3	12.9	4.1	43.6	11.7	63.3	43.0	9.3
2163	5.5	24.9	13.2	62.7	43.1	13.3	4.2	32.0	11.7	61.3	41.7	10.5
Tomahawk	4.8	36.8	15.3	58.7	39.6	11.9	4.1	37.3	12.7	60.6	40.7	10.0
Jagger	5.7	26.2	14.1	61.4	41.2	14.2	4.1	34.3	12.1	58.6	40.1	9.9
2137	5.0	23.2	14.0	60.9	41.7	14.1	4.0	38.9	11.0	58.9	40.4	9.3
Newton	4.9	36.1	14.5	60.9	40.3	13.4	4.2	33.5	12.4	63.6	42.7	10.9
Arkan	4.9	46.4	12.9	63.0	41.9	13.3	4.2	33.1	12.2	62.0	41.7	10.0
Barley												
Kanby	5.0	29.6	11.9	62.9	41.3	12.0	4.3	39.0	11.3	59.7	39.7	11.1
Post	6.3	26.4	13.0	62.7	41.4	12.7	4.2	34.5	12.7	58.0	39.1	11.8
Post 90	6.4	22.6	14.2	60.9	42.3	14.1	4.4	27.9	13.4	57.4	38.6	12.5
Triticale												
Presto	5.2	19.2	13.0	60.7	40.0	12.6	4.0	33.3	9.2	59.4	39.4	8.2
Average	5.3	29.3	13.5	61.5	41.3	13.2	4.2	35.5	11.7	60.2	40.6	10.2
LSD (P<.05) [2]	1.0	6.3	1.4	2.4	2.0	1.8	.3	9.8	1.9	6.0	2.1	1.6

[1]CP = crude protein; NDF = neutral detergent fiber; and ADF = acid detergent fiber.
[2]The LSD (least significant difference) is valid only within a column.