AGRONOMIC AND SILAGE QUALITY TRAITS OF WINTER CEREALS

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ABSTRACT
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 (*Hordeum* L.) had the highest whole-plant DM yield at the early-heading stage, and Presto triticale (*X Triticosecale* Wittmack) had the highest yield at the mid-dough stage. Newton wheat (*Triticum aestivum* L.) had the lowest whole-plant DM yield at both stages of maturity. Both crude protein (CP) and ash contents were higher for the early-heading than the mid-dough cereals. 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 had less than 60.0% NDF and 40.0% ADF. Extensive lodging occurred in virtually all cereals before the mid-dough stage harvest.

KEYWORDS
Winter cereals, silage, cultivar, maturity, yield

INTRODUCTION
Although winter cereals are generally planted for grain, they are also used as forage (e.g., pasture, hay, or silage) by many livestock producers in Kansas. Harvesting small grain cereals for forage has several advantages: 1) land might 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, e.g., 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 (Oltjen and Bolsen, 1983; Azimi, 1989) have shown that stage of maturity and cultivar have a large impact on both agronomic and silage quality traits of winter cereals. The objective of this experiment was to document agronomic performance and silage quality traits of several of the leading cultivars of different winter cereal species currently grown in Kansas.

METHODS
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 cultivars of wheat, three of barley, and one of triticale. The winter cereals were planted in a randomized complete block design with three replications. Single plots were 5.5 m wide and 9.0 m long. Anhydrous ammonia was applied at 90 kg of N ha^{-1}, and the seeding rate was 84 kg ha^{-1} for all cultivars.

The winter cereals were harvested at the early-heading and mid-dough stages of maturity. Four drill rows 5.5 m in length were harvested from each plot leaving a 10 cm stubble height. The early-heading stage harvest was between May 15 and 19, while 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 4 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 10 ¥ 25 cm 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, CP, NDF, ADF, and ash contents.

RESULTS AND DISCUSSION
The effect of stage of maturity at harvest on whole-plant DM content, DM yield, and silage quality traits is shown in Table 1. The first cutting of all cultivars originally was intended to be at the late-boot stage, but harvest was delayed by frequent rainfall and wet soils in May. The range in heads emerged was 23 to 87% (data not shown), and the range in the silage DM content at early-heading stage was 19.2 to 46.4% (data not shown). 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%, while 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 the triticale was taller than all eight wheat cultivars at the mid-dough stage.

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 30.0% and pH values at or above 5.0. Several of these silages had undergone secondary fermentations, which were characterized by the presence of excessive amounts of butyric acid and ammonia-nitrogen. The CP and ash contents were higher for the early-heading than the mid-dough cereals. 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 triticale, and the mid-dough stage Kanby, Post, and Post 90 barleys, had less than 60.0% NDF and 40.0% ADF contents.

REFERENCES
Azimi, S. 1989. Effects of maturity at harvest and conservation method on yield, chemical composition, and nutritive value of winter cereal forages. Ph.D. dissertation, Kansas State University, Manhattan.

Oltjen, J.W. and K.K. Bolsen. 1983. Wheat, barley, and oat silages for beef cattle. Technical Bulletin No. 613R, Kansas Agric. Exp. Sta., Manhattan.

Table 1
Effect of stage of maturity at harvest on whole-plant DM content, DM yield, and silage quality traits[z]

	Whole-Plant		Silage					
Stage of maturity	DM	DM Yield	pH	DM	CP	NDF	ADF	Ash
	%	T h^{-1}		%	------- % of the silage DM --------			
Early-heading	18.2	9.1	5.3	29.3	13.5	61.5	41.3	13.2
Mid-dough	36.7	11.4	4.2	35.4	11.7	60.2	40.6	10.2
LSD (P<0.05)[z]	1.9	0.3	0.2	2.1	0.4	1.4	2.4	0.5

[z]The LSD (least significant difference) is valid only within a column.