Studies on the Nutritive value of Wheat Pasture

R. R. Johnson, M. McGeehon, E. Williams[1] and H. C. Young, Jr.[1]

Story in Brief

Although wheat pasture constitutes a major source of winter pasture, its chemical composition and nutritive value have not been thoroughly studied. Samples of wheat pasture were harvested at several dates over a 2 year period and analyzed in the laboratory. They were fairly high in cell wall constituents but low in lignin suggesting these cell wall fractions were highly digestible. Wheat pasture varied from 9 to 25 percent soluble carbohydrate which is 100 percent digestible. The samples were all high in crude protein, averaging 29 percent, of which a significant portion was present as non-protein nitrogen.

Introduction

In Oklahoma, wheat along with other small grains constitutes a major source of winter pasture for both cattle and sheep. Rather remarkable performances in terms of growth rates have been reported indicating this material has a high nutritive value. Strangely enough, however, investigations of the ability of small grain pasture to satisfy specific nutrient requirements have not been made nor have the influences of factors such as season, variety, temperature variations and rust infections been studied. The results reported here are from a combined effort to study chemical changes in plant tissue associated with leaf rust infection and chemical constituents associated with nutritive value for the ruminant animal. Only the latter objective will be reported at this time.

Methods and Materials

During the 1970-71 season, wheat samples were harvested on 4 dates from the experimental plots at Goodwell, Oklahoma. A total of 10 samples were obtained each date, the samples representing 5 genetic lines in the sprayed (for leaf rust) and unsprayed condition. Ten samples representing 5 genetic lines were also harvested on Oct. 15 and Nov. 19, 1971, from Stillwater plots. All samples were dried at 55°C in a forced draft oven and ground through a 1 mm sieve for analysis. These dried samples were used to determine the composition of the cell wall frac-

[1] Department of Botany and Plant Pathology.

tion of the plant tissue.

The analyses consisted of neutral detergent fiber (NDF) which is the total cell wall, acid detergent fiber (ADF) which is primarily cellulose and lignin and acid detergent lignin (ADL). The non-lignin portion of plant cell walls represents the fibrous carbohydrate (cellulose and hemicellulose) that is available for digestion by rumen microorganisms while lignin is the non-digestible material that interferes with digestion of other portions of the plant.

During the 1971-72 season, samples were taken from 5 genetic lines in the Stillwater plots on four harvest dates and on one date, 10 samples of Triumph 64 were taken from greenhouse plots. These samples were frozen immediately upon harvest by placing in plastic bags and placing the bags in dry ice. The frozen plant tissue samples were then mixed with pulverized dry ice and passed through a pre-cooled Wiley Mill to grind the sample. After allowing the dry ice to dissipate in the freezer, the ground fresh-frozen samples were analyzed for dry matter, soluble carbohydrates, true protein-nitrogen and non-protein nitrogen by methods which will not be detailed in this report.

Results and Discussion

The results from analysis for cell wall constituents are presented in Table 1. NDF was higher for the samples harvested in January and March while ADF did not increase until March. These fractions would be expected to increase as soon as the wheat plants started their spring growth. In the two sets of samples harvested at Stillwater, the lignin (ADL) values were only about 3 percent. This together with the other analyses would suggest that the cell wall portion of the wheat plant tissue would be highly digestible. However, no digestibility measurements have been made as yet.

Table 1. Cell Wall Analysis of Wheat Pasture Samples Harvested In 1970 and 1971.

Harvest date	Location	No. Sples.[1]	NDF[2]	AF-NDF[2]	ADF[2]	ADL[2]
			--%, moisture free basis--			
10-30-70	Goodwell	10	34.8	31.2	18.2	-
12-12-70	Goodwell	10	28.7	24.9	16.0	-
1-29-71	Goodwell	10	44.2	39.7	17.2	-
1-30-71	Goodwell	10	44.4	41.5	22.5	-
10-15-71	Stillwater	10	-	-	24.0	3.13
11-19-71	Stillwater	10	-	-	22.5	2.89

[1] The 10 samples represented 5 genetic lines. There were no differences between genetic lines.
[2] NDF=neutral detergent fiber; AF-NDF=ash free NDF; ADF=acid detergent fiber and ADL=acid detergent lignin.

Table 2 presents the results from analysis for soluble carbohydrates and nitrogen fractions. In contrast to the cell wall constituents, soluble carbohydrates are generally fermented very rapidly by the rumen microorganisms and are usually 100 percent digestible. They are made up of simple sugars and soluble starch fractions. Ordinarily, significant quantities of soluble carbohydrates occur only in the vegetative stage of plant growth or in plants having high potential for seed formation (e.g., the corn plant). Dried winter forages contain practically none. As can be seen in Table 2, the soluble carbohydrate content of wheat pasture plants varied from 9 to 25 percent of the dry matter. Such a high level of soluble carbohydrate would certainly partially account for the high energy value of this material and its ability to support rapid animal gains.

Table 2. Dry Matter, Soluble Carbohydrate and Nitrogen Fractions in Wheat Pasture Samples Harvested in the 1971-72 Season.

Harvest Date	No. Spls.	Dry Matter	Soluble Carbohydrates	Nitrogen		
				Crude Protein	% of N as: NPN	True Protein
		%	%, moisture free basis		%	%
10-19-71	10[1]	13.7	10.3	27.9	13.1	86.9
11-30-71	10[1](6)[2]	20.2	25.1	25.2	11.6	88.4
1-25-72	10[1]	22.2	18.2	31.7	27.5	72.5
3- 2-72	3[3]	23.3	–	30.9	15.1	84.9
	10[4]	14.5	9.3	–	–	–

[1] Averages of 10 samples which included 5 genetic lines.
[2] Sufficient quantity for nitrogen fractionation was available for only 6 samples.
[3] Sufficient quantity was available for only 3 samples.
[4] 10 samples of Trumph 64 from greenhouse tests.

The crude protein content was high at all times, varying from 25 to 32 percent of dry matter. This is far in excess of any requirement the animals might have. There are apparently still some cattlemen providing protein supplement to animals on wheat pasture and these results would indicate that this is an unnecessary practice. Furthermore, of the nitrogen present, as much as 27 percent was present as non-protein nitrogen. Although the rumen microorganisms have the capacity for utilizing NPN, the presence of this much in companion with high protein levels suggests that rapid liberation of ammonia from these materials could conceivably cause ammonia toxicity. This possibility is under further investigation at this time.