A STUDY OF CERTAIN FACTORS WHICH AFFECT THE CALCIUM, PHOSPHORUS, AND NITROGEN CONTENT OF PRAIRIE GRASS

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The data reported in this paper were obtained during the last three years from grasses secured from different counties in the state so that a study of the effect of climatic and soil conditions on the growth of plants could be made. The grass samples used for analysis were carefully selected from typical pasture land or from virgin soil. These samples represent different species of mature grasses and were taken in the fall of 1929, 1930, and 1931. Samples of grass which were used in the seasonal variation study were taken about the first of each month from May until August, 1931. All of the plants were analyzed for total nitrogen, phosphorus, and calcium by official methods recommended by the American Association of Agricultural Chemists.

The data presented in Table I show the chemical composition of the different grasses studied. This information indicates that there was a marked variation in composition between the different species of grass. The Blue stems, Switch grass, and Indian grass are plants which are very low in phosphorus. The phosphorus content of these plants varied from 0.0724 to 0.109 per cent. The calcium, on the other hand, was rather high, while the nitrogen content of these plants was also very low when compared with the other species of grasses. Wild rye, Redtop, and Giant Reed grass were high in phosphorus and low in calcium, while the nitrogen was about the same as that found in the other plants. The calcium content of these grasses was extremely low and varied from 0.1308 to 0.1911 per

cent. It has been found that when plants which contain very low amounts of calcium are fed to livestock, abnormal development of animals may occur. This factor is important from the standpoint of livestock production in Oklahoma.

COMPOSITION OF GRASSES

TABLE I
A Study of the Mineral Content of Oklahoma Prairie Grass

Common Name	Botanical Name	No. of Samples	Calcium	Phosphorus	Nitrogen
Buffalo Grass	Buchloe dactyloides	3	0.3617	0.1996	1.1422
Orchard Grass	Dactylis glomerata	1	0.3402	0.2050	
Little Blue Stem	Andropogon scoparius	11	0.3209	0.0832	0.8435
Big Blue Stem	Andropogon furcatus	16	0.3153	0.0952	0.6927
Mixture of Big and Little Blue Stem	Andropogon furcatus and scoparius	18	0.2983	0.0724	0.8074
Switch grass	Ponium vergatum	7	0.2936	0.1097	0.9813
Indian grass	Sorghostrum nutons	5	0.2787	0.0786	0.8624
Italian Rye Grass	Lolium multiflorum	1	0.2486	0.1880	
Giant Reed grass	Calamovilfa longifolia	1	0.1911	0.1777	0.5775
Wild Rye grass	Elymus verginicus	6	0.1868	0.1233	1.0156
Redtop	Agrostis alba	3	0.3760	0.2030	1.047
Hairy vetch	Vicia villosa	10	1.1615	0.3159	3.0315
Mixture of Big and Little Blue Stem	Andropogon scoparius and furcatus				
Check	No fertilizer	8	0.3630	0.0790	0.6390
Fertilized	N. P. K.	8	0.3540	0.0844	0.6390

Buffalo grass, Orchard grass, Redtop, and Italian Rye grass are grasses which are high in calcium, phosphorus, and nitrogen. These grasses, however, are very low in mineral content as compared with legumes. This is well illustrated by the analyses of Hairy vetch which has been included in Table I.

These data also show that the phosphorus content of the Blue stems was increased slightly when an application of complete fertilizer was applied to the soil. A decrease in the calcium content of the fertilized grasses occurred while the nitrogen content of the fertilized and unfertilized plants remained about the same.

Because of some variations which occurred in the mineral content of samples of the same kind of grass which were grown on different soils, a sample of soil was secured from each area where a grass sample was obtained and an analysis was made for easily soluble phosphorus and calcium. There was a tendency for the grass plants to be higher in calcium and phosphorus when grown in fertile soil; however the data indicate that the kind of plant is more important than either the soil or soil treatment in determining the amount of mineral which will be present in the forage. Data on the effect of seasonal variation on the mineral content of the grass is shown in Table II. A study of these data show that the per cent of nitrogen, phosphorus, and calcium which was found in

TABLE II

A study of the composition of prairie grass at different stages of maturity

County	Botanical Name	May			June			July			August		
		Cal.	Phos.	Nit.	Cal.	Phos.	Nit.	Cal.	Phos.	Nit.	Cal.	Phos.	Nit
Carter	Andropogon scoparius and furcatus	0.323	0.222	2.429	0.301*	0.264*	2.352*	0.317*	0.105*	1.036*	0.272*	0.106*	1.040*
Craig	Andropogon scoparius and furcatus	0.341	0.175	2.118	0.404	0.133	1.701	0.354	0.082	1.201	0.406	0.070	
Greer	Andropogon furcatus	0.675	0.395	2.335	0.614	0.221	1.523	0.557	0.151	0.942	0.467	0.120	0.756
Latimer	Andropogon scoparius and furcatus	0.307	0.254	2.307	0.335	0.196	1.540	0.386	0.102	0.879	0.333	0.114	0.777
Latimer	Andropogon scoparius and furcatus				0.386	0.180	1.775	0.386	0.078	0.851	0.358	0.066	0.710
Latimer	Andropogon scoparius and furcatus				0.548	0.139	1.414	0.435	0.080	1.889	0.331	0.076	0.508
Le Flore	Andropogon scoparius and furcatus				0.211	0.201	1.610	0.177	0.190	1.606	0.226	0.072	1.327
Nowata	Andropogon scoparius and furcatus				0.636	0.222	1.775	0.354	0.126	1.190	0.293*	0.088*	1.403*
Pawnee	Andropogon scoparius and furcatus	0.266	0.231	2.066	0.360	0.120	1.407	0.321	0.091	0.970	0.325	0.060	0.728
Payne	Andropogon scoparius and furcatus	0.455	0.330	2.636	0.545	0.178	1.712	0.500	0.115	0.900	0.392	0.077	0.834
Texas	Buchloe dactyloides				0.440	0.259	1.586	0.413*	0.189*	1.110*	0.341	0.148	0.728
	AVERAGE	0.395	0.268	2.315	0.435	0.192	1.672	0.382	0.119	1.057	0.341	0.091	0.881

*Clippings

the samples of grass secured from the different counties varies considerably. The total nitrogen and phosphorus content of the plants gradually decreased from May until maturity.

Although a considerable fluctuation was secured in case of some of the samples, all of the grasses were higher in phosphorus content in May than in June except one sample which was secured from Carter county. This sample was the second growth of young grass which was secured from a plot which was clipped in May and would not be typical of grass allowed to grow until June before it was harvested. The average for May shows 0.268 per cent of phosphorus on a dry weight basis, decreasing until August, when it is only 0.091 per cent. There appears to be a close correlation between the nitrogen and phosphorus content of the different plants. All of the grasses were highest in nitrogen in May. The average for all plants was 2.315 per cent, which gradually decreased to .881 per cent in case of the August samples.

Some of the samples contained the highest calcium content in May with a gradual decrease until maturity, but the average calcium content of all samples increased from May until June and then gradually decreased until August. The increase in calcium content from May to June is rather hard to explain, since the plants are growing rapidly during this period, and a decrease in nitrogen and phosphorus content occurs. There are several possibilities which might be suggested as responsible for this condition. An increase in the nitrification of soil nitrogen may be responsible for this increase during the latter part of May and the first of June, because calcium would be taken into the plant in the form of calcium nitrate, but this probably would not account for all the decrease in the nitrogen content of the plants. Another factor which might be responsible for the increase in calcium in the plant is the increase of calcium bicarbonate in the soil solution. Such an increase is due to an increase in carbon dioxide production from the decay of organic matter in the soil. This condition would make more calcium available for the plants to use and would tend to increase the per cent of calcium in the plant.

It is possible that the increase in calcium during the latter part of May could be due to an increase in the amount of insoluble calcium oxalate which is formed as a result of reactions taking place in the synthesis of proteins.

Another possibility is that the early growth of the grass may be produced from stored food in the roots, and the calcium content of the plant increases during the early development from calcium absorbed from the soil solution.

All of these factors probably contribute to the changes in the calcium content of the plant at different periods in its development.