EFFECT OF DIFFERENT HEIGHTS OF CLIPPING, RATES OF NITROGEN FERTILIZATION, AND DATES OF CLIPPING ON YIELD, CHEMICAL COMPOSITION, AND ROOT PRODUCTION OF BERMUDA GRASS, CYNODON DACTYLON (L.) PERS., AND BUFFALO GRASS, BUCHLOE DACTYLOIDES, (NUTT.), ENGELM.

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INTRODUCTION

General knowledge is rather extensive pertaining to the management methods and variations in chemical composition of most grasses. However, little specific information is available regarding the use and management of buffalo grass, *Buchloe dactyloides* (Nutt.), Engelm., and bermuda grass, *Cynodon dactylon* (L.) Pers.

Any information on the management methods for these two grasses would be of considerable benefit to persons interested in the use of the grasses for turf purposes, and clipping and fertilizer studies would serve the purpose of supplying data needed in order to best use these grasses for lawns, golf greens and fairways, airports, parks, highways, etc.

Any information on the variations in yields as well as chemical composition would be of value to the rancher and farmer and would help them to derive the maximum benefits in the use of these two grasses for pastures and for livestock feed.

Inasmuch as bermuda and buffalo grass are well adapted to Oklahoma, specific knowledge about the grasses would be of considerable value, and would offer a guide to the best use of the grasses for turf and forage in this region.

In March, 1948, an experiment was initiated at the Oklahoma Experiment Station in cooperation with the Oklahoma Turf Association, with the objective of studying the effects of different dates, heights of clipping, and rates of nitrogen fertilization on the yield, chemical composition, and root production of bermuda grass and buffalo grass.

REVIEW OF LITERATURE

Newell and Keim (15) [1] working in Nebraska, reported that frequent mowing of buffalo grass produced higher yields than when cut once for hay. Their figures, averages for a 3-year study, showed a yield of 1.00 ton per acre when clipped once, compared to 1.42 tons when clipped several times each season. However, in an experiment conducted in Kansas (20) over a 6-year period, yields of air-dry buffalo grass averaged 456 pounds per acre when clipped an average of 6 times from May 15 to September 1. In the same study, buffalo grass clipped on July 1 and September 15 produced an average air-dry grass yield of 823 pounds per acre. Similar results were obtained in Texas by Dickinson (7), where clipping at 8-week intervals gave higher yields than more frequent cutting. Carter and Law (4) conducted clipping experiments in Washington with several grasses and found that clipping under greenhouse conditions caused a great reduction in top growth. Clipping intervals of 15 days gave yields only about 6% as great as yields of unclipped plants, and clipping at 30-day intervals gave yields approximately 20% as much as the yields of unclipped plants. Work reported by Crozier (5) at the Michigan Experiment Station showed in clipping studies with timothy and orchard grass that a single cutting of hay produced from 2 to 10 times as much forage as when cut at regular intervals throughout the growing season. Like results have been reported by Biswell and Weaver (2) in Nebraska, Wenger (20) in Kansas, and Mortimer and Ahlgren (13) in Wisconsin.

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[1] Figures in parentheses refer to "Literature Cited", page 28

Studies made by a number of experimentors have shown that the protein content of grasses is greatly affected by clipping. Newell and Keim (15) have shown in their investigations with buffalo grass that frequent clipping increased the protein content from 9.3% for unclipped plants to 11.7% for frequently clipped plants. Similar results were obtained in studies with timothy (5), where frequent clipping increased the protein content from 7.18% to 22.62%.

Application of nitrogenous fertilizers increased the protein content of pasture grasses at Beltsville, Maryland, according to Vinall and Wilkins (19). It was reported by Munsell and Brown (14) in Connecticut that several applications of nitrogenous fertilizers during the growing season kept the nitrogen content of grass at a fairly uniform, high level. The protein content of grasses varied directly with the amount of nitrogenous fertilizers added, according to Mortimer and Ahlgren (13).

It was found by Harrison (11), working in Michigan, that nitrogen fertilization brought about an increase in top growth of grasses but that the weight of the roots did not respond to fertilizer applications when the ability of the plant to manufacture carbohydrates was impaired by removal of the leaves, Gernert (10), working with native grasses in Oklahoma, found that frequent clipping of top growth resulted in a reduction in root growth. A positive correlation coefficient of 0.82 for dry weight of roots with top production was reported by Carter and Law (4).

A number of investigators have concluded that the chemical composition of grasses is influenced by several factors. The effect of added nitrogen was greatest in clippings made during the first month after fertilization, according to Munsell and Brown (14). Danields (6) found that the nitrogen and phosphorus content of buffalo grass in Oklahoma was highest in early summer and decreased during the growing season. The protein content of grasses was noted to decrease as the plants matured, being highest during the spring immediately following fertilization, (8), (9).

Bell and DeFrance (1), working with bent grasses in Rhode Island, concluded that a 10-6-4 fertilizer applied once during the growing season would keep turf in good condition. Their general recommendation was for 2 parts of nitrogen to 1 part of phosphoric acid for a balanced fertilizer. Recommendations made by Sprague (18) were for the application of nitrogen both in early spring and in autumn to maintain established turf. Nitrogen was of most value if a third of it was supplied from slowly available organic materials, such as tankage, cottonseed meal, or soybean meal. Fertilizers were of little value to buffalo grass, according to Zahnley (21). It was not injured by close clipping, but needed frequent mowing to keep down competition from other plants. Further recommendations for fertilizing turf grasses have been given by Munsell and Brown (14), Mortimer and Ahlgren (13), and Vinall and Wilkins (19).

Phosphorus has been shown to increase the calcium content of grasses, suggesting that the amount of available phosphorus in the soil affects the ability of the grass to utilize calcium (19).

Most turf grasses should be kept below 2 1/2 inches, but not less than 1 inch for best growth, according to Sprague (16). He suggested that grasses not be allowed to produce seed heads, as this would exhaust the food reserves and would retard leaf and shoot development. Mowing of grasses should be discontinued as early as possible in the fall, according to Harrison (11). Such a practice will enable the plants to store food for use during the season of short and frequent clipping. Wenger (20) reported that a satisfactory lawn of buffalo grass may be maintained in Kansas without the use of water, if clipping is practiced and the turf does not receive excessive wear. However, watering will keep the buffalo turf in nicer condition, especially during the hot summer months. The height of clipping of unwatered buffalo turf should be between 1 and 2 inches, and between 3/4 and 1 inch for watered buffalo grass lawn. In New Jersey, Sprague and Evaul (17) suggested that the mowing height of turf depended on two principal factors: (a) the use to be made of the turf, and (b) the ability of the grass to withstand close clipping. They recommended that lawns and fairways be mowed not closer than 3/4 inch. Close mowing caused shallow root penetration and poor utilization of moisture (16). Cutting at 1 1/4 to 1 1/2 inches increased the durability of the turf during the hot dry periods. Mowing also encouraged the grass to spread, made the lawn more attractive, and discouraged growth of weeds (3).

Stephens (18) working at the Oklahoma Experiment Station in 1949, reported data on the management of bermuda and buffalo grass. He showed that forage yields of both grasses were highest at clipping heights of 5/8 inch, and that yields became less at greater heights of clipping. Fertilization with ammonium nitrate increased forage yields as well as protein content, but showed no marked influence on the calcium and phosphorus content. General appearance of the turf of both grasses was best at clipping heights of 1 inch. Weeds became prevalent on the buffalo grass plots clipped at 2 inches.

METHODS AND MATERIALS

In March 1948, a three-year experiment was initiated to study the effects of nitrogen fertilization and various clipping heights on the yields and chemical composition of bermuda and buffalo grass. In 1949 an additional factor was studied - the effects of the various treatments on the root production of both grasses.

Natural stands of both grasses were selected. A split-plot design was used, with two replications of 3 clipping treatments as the main plots, and 4 fertilizer treatments randomized within each main plot as sub-plots. The heights of clipping were 5/8, 1, and 2 inches. For the fertilizer treatments, ammonium nitrate was applied once during the season, in April, at rates of 0, 50, 100, and 150 pounds of nitrogen per acre.

The buffalo grass plots were located about four miles east of Stillwater on the Thomas farm. The soil type was a Kirkland very fine sandy loam. There were 24 plots, each 8 x 25 feet, and arranged in two replications. The plots in each replication were adjacent to each other, with a 2-foot alley between replications. The ammonium nitrate was applied to the buffalo grass plots on April 21, 1949.

The bermuda grass plots were located on the Agronomy Experimental Farm one mile west of Stillwater. The soil type was a Kirkland fine sandy loam. Individual plots were 9 x 16 feet, and there was no alley present between either individual plots or between replications. The bermuda grass plots were fertilized on April 22, 1949.

A powered lawn mower was used to clip the plots at such times as yields were obtainable at the various clipping heights. Immediately after clipping, the green forage was weighed, and a composite sample of 500 grams taken from each plot for moisture determinations. After the termination of the growing season, a portion of each sample retained was analyzed for chemical composition. Determinations were made for nitrogen, protein, calcium, ash, and phosphorus. The analyses were made in the soils laboratory at Oklahoma A. and M. College, according to the methods outlined by Dr. Horace J. Harper. /2

In January 1950, three root samples were taken at random from each plot at both locations. The plugs taken measured 6 inches in depth and 4 1/2 inches in diameter. These were washed free of soil, and oven-dry weights for each root sample obtained. The three samples from each plot were weighed and the average of the three weights used for calculations.

Analyses of variance were made for yields, chemical composition, and root weights according to the methods suggested by Leonard and Clark (12).

/2 Tentative Methods for the Analysis of Soil and Plant Material. Compiled by Horace J. Harper, Soils Laboratory, Oklahoma A. and M. College. June 1948.

EXPERIMENTAL RESULTS

Climatic Conditions

The growing season in 1949 was generally favorable. Precipitation for the entire year was slightly below normal, as were mean temperatures. Abundant rains occurred during May and the following 3 months were below normal for precipitation, with abundant rains in September. Temperatures during the same period were slightly below normal.

General Condition of the Turf

Fertilization of the grasses with ammonium nitrate produced a marked change in color. The bermuda grass took on a dark green color, the degree of color varying with the amount of nitrogen added. The buffalo grass developed a dark green color in contrast to the normal color of buffalo grass which is bluish-green. In general the plots of both bermuda and buffalo grass that were clipped at 1 inch had the best appearance, while the plots clipped at 5/8 inch were barren in some spots due to the mower reel hitting the ground on uneven places. The plots clipped at 2 inches had rather an unkempt appearance throughout the summer. Abundant rainfall during the month of May kept the turf in good condition, promoting rapid growth and maintaining desirable dark color. However, the rainfall leached out some of the nitrogen fertilizer, and the grasses lost some of the dark green color during the summer.

During June and July, rainfall was sparse, growth of both grasses slowed down, and the turf became dry and brown. In addition, weeds invaded some plots, being especially prominent on the low-clipped plots of bermuda grass and on the high-clipped plots of buffalo grass. The most prevalent weeds noted were ground cherry, Physalis subglabrata Mack and Bush, bull nettle, Solanum eleagnifolium Cav., and smartweed, Polygonum pennsylvanicum

L. A number of grasses invaded some plots, mainly big bluestem, *Andropogon furcatus* Muhl., green foxtail, *Setaria viridis* (L.)Beauv., silver beard-grass, *Andropogon saccharoides* Swartz, and windmill grass, *Chloris verticilata* Nutt.

Yields, Chemical Composition and Roots Weights

Bermuda Grass

Average forage yields tended to decline during the growing season (Table 1), with the exception of the July 8 cutting which was the highest of the six clippings. The lowest average yield was obtained on September 6. Average yields of the plots clipped at 5/8 and 1 inch were not significantly different but both were highly significantly greater than the average yield from plots clipped at 2 inches. Plots receiving 50 pounds of nitrogen per acre gave the lowest average yields, and the average yields from unfertilized plots were slightly, but not significantly, higher. Plots fertilized at rates of 100 and 150 pounds of nitrogen per acre gave significantly higher yields than either of the plots receiving less nitrogen. The basic data (Table 7) show that in several instances plots that received no nitrogen gave somewhat higher yields than plots fertilized with 50 pounds of nitrogen per acre. Such irregularities were possibly due to localized drainage or soil conditions. The mean squares for yield (Table 2) show differences in yields between dates and between heights of clipping to be significant at the 5% level. Differences in yields due to fertilizers were significant at the 1% level. The interactions of dates x heights, heights x fertilizers, and dates x fertilizers were significant at the 1% level.

Table 1. Mean and least significant values for yields and chemical composition of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Variant	Dry weight Yields Lbs./A.	Protein %	Ash %	Calcium %	Phosphorus %
Dates					
May 23	466	15.95	5.15	.56	.284
June 13	353	15.49	10.90	.53	.445
July 8	638	13.66	11.49	.49	.276
August 1	319	11.51	10.31	.50	.267
September 6	103	10.41	8.97	.46	.244
September 30	277	10.56	12.26	.69	.228
L.S.D. - 5% level	247	*	1.43		.035
L.S.D. - 1% level	387		2.24		.056
Heights of clipping					
Low - 5/8"	412	13.34	10.23	.53	.309
Medium - 1"	403	12.81	9.45	.52	.284
High - 2"	279	12.63	9.86	.56	.270
L.S.D. - 5% level	79			.12	.033
L.S.D. - 1% level	182			.27	.076
Fertilizers (lbs. N per acre)					
0	332	12.94	10.10	.53	.296
50	304	12.67	9.20	.56	.281
100	399	13.01	10.20	.54	.290
150	423	13.09	9.89	.53	.283
L.S.D. - 5% level	44	.26	.50	.02	.011
L.S.D. - 1% level	58	.34	.65	.03	.014

* Blank indicates no significance

Table 2. Mean squares for yield and chemical composition of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Source of Variation	Degrees of Freedom	Mean Squares: Yield	Protein	Ash	Calcium	Phosphorus
Replications	1	35,124.93	1.42	11.82	.1534	.0258*
Dates	5	623,260.95*	144.71**	156.93**	.1640	.1582**
Error a	5	110,373.68	1.70	3.70	.1743	.0023
Date of clipping plots	11	336,663.46	66.68	74.09	.1677	.7526
Replications	1	35,124.93	1.42	11.82	.1534*	.0258
Heights of clipping	2	265,530.13*	6.73	7.29	.0170*	.0185*
Error b	2	8,031.57	.96	1.28	.0018	.0014
Height of clipping plots	5	145,562.08	4.20	7.24	.0480	.0164
Date of clipping plots	11	336,663.46	66.68	74.09	.1677	.7526
Height of clipping plots	4	145,562.08	4.20	7.24	.0480	.0164
Dates x heights	10	97,507.89**	8.70**	1.41	.0407**	.0019**
Fertilizers	3	112,500.03**	1.27**	7.37**	.0102**	.0016*
Heights x fertilizers	6	41,686.37**	12.73**	5.58**	.0060**	.0013*
Dates x fertilizers	15	51,833.27**	2.15**	1.82	.0064**	.0003
Error c	94	8,896.22	.30	1.12	.0017	.0005
Total	143					

* F value exceeds 5% level of significance
** F value exceeds 1% level of significance

Mean percentages of protein (Table 1) were highest in the May 23 clipping, and declined during the season. The average reduction from first to last cutting was 5.39%. The average protein content from plots clipped at 5/8 inch was the highest, and the protein content decreased with increased heights of clipping. However, the differences in protein content at different clipping heights was not significant. Plots fertilized with 150 pounds of nitrogen per acre showed the highest average protein content, although it was not significantly higher than the average of plots fertilized with 100 pounds of nitrogen per acre. Average protein content of the plots fertilized at the 50 pound rate was the lowest, being significantly lower than the average protein content of unfertilized plots or plots fertilized with 100 pounds of nitrogen per acre. The mean square for dates (Table 2) was highly significant, as was the mean square for fertilizer comparisons. Comparison of heights of clipping showed no significant differences and verifies the lack of significance between mean protein content at different heights. The interaction dates x heights was significant at the 1% level although the percentage of protein were highest on plots clipped at 5/8 inch on most dates. Heights x fertilizers and dates x fertilizer effects were inconsistent, but significant at the 1% level.

The average ash content of bermuda grass was irregular throughout the season (Table 1). The May 23 clipping contained an average of 5.15% ash and was the lowest average for all dates of clipping. The clipping made September 30 had the highest average ash content, 12.26%. The height of clipping had little effect on average ash content. Ash content on the low-clipped plots was the highest, but not significantly so. Effects of fertilizer were irregular, with the average percent ash being highest on the plots fertilized at rates of 100 and 0 pounds of nitrogen, in that order. The percent ash on plots receiving 50 pounds of nitrogen was lowest, and the percent from plots fertilized with 150 pounds of nitrogen was next lowest. The mean squares for date and for fertilizer comparisons (Table 2) were significant at the 1% level. Heights of clipping showed no significant effects on ash content. Of the interactions, only heights x fertilizers was significant, this at the 1% level.

Date of clipping had little effect on the average calcium content of bermuda grass, and the percent of calcium varied irregularly (Table 1). Plots clipped at 2 inches had the highest average calcium content, 0.56%; this was significantly higher than the average content at the two lower clipping heights. The effects of added nitrogen were irregular, although significance at the 5% level was obtained for comparison of all fertilizer rates. The mean square (Table 2) for comparison of dates was not significant, and comparison of clipping heights was significant at the 5% level. Fertilizer comparisons were significant at the 1% level. Significance at the 1% level was obtained for dates x heights, dates x fertilizers, and heights x fertilizers.

The average phosphorus content of bermuda grass tended to decrease during the clipping season after the second clipping (Table 1). The highest average phosphorus content (0.445%) was obtained on June 13, the lowest (0.228%) on September 30. Average phosphorus content showed a consistent decrease with increased heights of clipping, the difference between extremes just slightly exceeding the difference required at the 5% level. Differences in phosphorus content on plots fertilized with 0 and 100 pounds of nitrogen per acre were not significant. Differences in average phosphorus content of plots receiving 50 and 150 pounds of nitrogen were not significant, although both were significantly lower than the averages of the other two plots. The mean squares presented in Table 2 show dates x fertilizers interaction to be non-significant. Significance at the 5% level was obtained for fertilizer and height of clipping comparisons and for heights x fertilizer interaction. Date x height interaction was significant at the 1% level although the basic data (Table 11) shows that in general the phosphorus content was highest on low-clipped plots for all dates of clipping.

Average dry root weights were unexplainably higher on plots clipped at 5/8 inch, and lowest on plots clipped at 2 inches, (Table 3). However, differences between average root weights under any two clipping heights were not significant. Root weights on plots fertilized with 50 pounds of nitrogen were highest, followed by plots fertilized with 150, 0, and 100 pounds of nitrogen per acre, in that order. Difference between average root weights on plots fertilized with 50 pounds and 150 pounds of nitrogen were not significant, nor were differences between plots receiving 0 and 100 pounds of nitrogen per acre. Differences between the two highest average root weights and the two lowest average root weights were significant. The mean squares for dry root weights (Table 4) showed no significance between height of clipping effects. Significance at the 5% level was obtained for fertilizer comparisons, and the interaction heights x fertilizers. Basic data (Table 12) show that root weights for clipping height of 5/8 inch were highest in combination with 50 pounds of nitrogen; highest weights for 1 inch-clipped plots were obtained in combination with 150 pounds of nitrogen; and highest weights for 2-inch-clipped plots were obtained in combination with 50 pounds of nitrogen per acre.

Table 3. Mean and least significant values for dry weights of roots of bermuda grass and buffalo grass as affected by different heights of clipping and rates of nitrogen fertilization, Stillwater, 1949.

Variant	Bermuda (grams)	Buffalo (grams)
Heights of clipping		
Low - 5/8"	9.38	5.13
Medium - 1"	8.25	5.50
High - 2"	8.13	4.50
L.S.D. - 5% level	*	
Fertilizers (lbs. N per acre)		
0	7.83	5.66
50	9.50	4.83
100	7.66	4.83
150	9.33	4.83
L.S.D. - 5% level	.80	

* Blank indicates no significance

Table 4. Mean squares for dry weights (grams) of roots of bermuda grass and buffalo grass as affected by different heights of clipping and rates of nitrogen fertilization, Stillwater, 1949.

Source of Variation	Degrees of Freedom	Mean Squares	
		Bermuda	Buffalo
Replications	1	2.66	0.38
Heights of clipping	2	3.79	2.045
Error a	2	3.80	3.87
Fertilizers	3	5.61*	1.043
Heights x fertilizers	6	5.07	1.37
Error b	9	1.86	0.38
Total	23		

* F value exceeds the 5% level of significance

Buffalo Grass

Wide differences were obtained between the average dry weight yields of the first two cuttings and the last two (Table 5). The clippings made on June 6 and July 2 were not significantly different, but both were different at the 5% level from the two later cuttings made on August 3 and September 29. Yield on July 2 was the highest, being 273 pounds per acre, and the yields on the subsequent dates were only about 25% as great. Height of clipping of 5/8 inch gave the highest average yield, 279 pounds per acre, followed by 166 pounds on the medium-clipped plots, and 48 pounds on the high-clipped plots. Differences between any two heights of clipping are significant at the 1% level. Average yields increased with increased amounts of nitrogen fertilizer. Differences between the plots fertilized at 0 and 50 pounds of nitrogen per acre were not significant nor were differences between the rates of 100 and 150 pounds of nitrogen. However, the difference between the averages of the two lower rates and the averages of the two higher rates were significant at the 1% level. Mean squares for yields (Table 6) showed significance at the 5% for comparison of dates of clipping. Height of clipping and fertilizer comparisons showed significance at the 1% level, as did dates x heights, heights x fertilizers, and dates x fertilizers.

The average protein content of buffalo grass showed a gradual decrease during the summer (Table 5). Differences between the average protein content on June 6 and July 2 were not significant, and both were significantly higher than the average protein content of grass clipped on August 3. The average protein content from the September 29 clipping was 9.48%, a decrease of 2.47% from the protein content of the clipping made June 6. Protein

Table 5. Mean and least significant values for yields and chemical composition of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Variant	Dry weight Yields Lbs./A.	Protein %	Ash %	Calcium %	Phosphorus %
Dates					
June 6	236	11.95	7.95	.56	.140
July 2	273	11.82	8.02	.41	.143
August 3	70	10.39	6.71	.55	.138
September 29	78	9.48	8.88	.67	.138
L.S.D. - 5% level	43	1.01	1.06	.10	*
L.S.D. - 1% level	80	1.85	1.94	.17	
Heights of clipping					
Low - 5/8"	279	11.42	8.09	.54	.147
Medium - 1"	166	10.84	8.06	.52	.141
High - 2"	48	10.47	7.52	.57	.131
L.S.D. - 5% level	17				.008
L.S.D. - 1% level	39				.018
Fertilizers (lbs. N per acre)					
0	131	10.12	8.28	.55	.141
50	141	10.80	8.22	.56	.144
100	185	11.07	7.73	.56	.138
150	199	11.65	7.34	.53	.134
L.S.D. - 5% level	23	.50	.44	.12	.009
L.S.D. - 1% level	32	.71	.63	.17	.012

* Blank indicates no significance

Table 6. Mean squares for yield and chemical composition of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Source of Variation	Degrees of Freedom	Mean Squares				
		Yield	Protein	Ash	Calcium	Phosphorus
Replications	1	12,037.76	5.84	5.16	.0305	.000026
Dates	3	267,619.43*	34.03*	19.07*	.2786*	.000082
Error a	3	2,249.60	1.20	1.32	.0107	.000132
Date of clipping plots	7	117,377.83	15.93	9.47	.1283	.000035
Replications	1	12,037.76*	5.84	5.16	.0305	.000026
Heights of clipping	2	425,107.01**	7.49	4.87	.0158	.002260
Error b	2	252.95	2.98	6.59	.0052	.000051
Height of clipping plots	5	215,689.42	6.67	7.02	.0106	.001113
Date of clipping plots	7	117,377.83	15.93	9.47	.1283	.000035
Height of clipping plots	4	215,689.42	6.67	7.02	.0106	.001113
Dates x heights	6	59,631.22**	1.78*	2.93**	.0250**	.001061**
Fertilizers	3	26,193.26**	9.75**	4.73**	.0030	.000583*
Heights x fertilizers	6	3,876.84**	2.30**	1.60**	.0069	.000585**
Dates x fertilizers	9	3,611.70**	1.85**	.487	.0167**	.000185
Error c	10	1,230.71	.61	.467	.035	.000181
Total	95					

* F value exceeds 5% level of significance
** F value exceeds 1% level of significance

content was highest in grass clipped at 5/8 inch, and decreased with higher heights of clipping. Differences between protein content at different clipping heights were not significant, however. Addition of nitrogen effected an increase in average protein content. The increase between the check plot and the plots fertilized with 50 pounds was not significant, although higher rates of fertilization showed increases significant at the 1% level over that of the unfertilized plots. Mean squares (Table 6) show the differences between dates to be significant at the 5% leve, while differences due to heights of clipping were not significant. Significance at the 1% level was obtained for fertilizers, heights x fertilizers, and dates x fertilizers. Dates x heights showed significance at the 5% level.

Mean ash content of buffalo grass fluctuated during the season, (Table 5) with the highest average percent in the clipping made September 29. The average for that date was 8.88% and was not significantly different from the 8.02% obtained on July 2, or 7.95% obtained on June 6. The average of 6.71% obtained on August 3 was significantly lower than any of the other three. Heights of clipping showed no significant effects on the ash content, although there was a slight tendency for the ash content to be highest on lowest-clipped plots. Effects of fertilizers showed that the ash content decreased somewhat with the addition of nitrogen. The mean square for the date comparison was significant at the 5% level, and there was no significant difference between ash content at different heights of clipping. Dates x heights, fertilizers, and heights x fertilizers showed highly significant effects.

Significant differences were obtained between average calcium content on different dates (Table 5), though such differences were irregular. Average calcium content was highest from plots clipped at 2 inches, although not significantly higher than the calcium content from lower clipped plots. Nitrogen fertilization caused no marked effects on the calcium content as the average calcium percentage ranged between 0.55% and 0.56%, with a difference of 0.12% required for significance at the 5% level. The mean squares tabulated in Table 6 show significance at the 5% level for comparison of dates, no significance for either height of clipping or fertilizer comparisons, and significance at the 1% level for dates x heights and dates x fertilizers. This indicated that dates were the dominant factors governing calcium content, either when considered alone or as an interaction with heights or fertilizers. Basic data in Table 15 show that calcium content varied greatly between dates, and within dates.

The average phosphorus content (Table 5) varied little during the season, the range being 0.005%. The average phosphorus content was highest on the plots clipped at 5/8 inch, and decreased on plots clipped at 1 and 2 inches. There was a tendency toward a decrease in phosphorus content with the addition of nitrogen, and significance at the 5% level was obtained between plots fertilized at rates of 50 pounds of nitrogen and 150 pounds of nitrogen per acre. Mean squares (Table 6) show effects of dates to be insignificant, while heights of clipping were highly significant. Fertilizer effects were significant at the 5% level, and dates x heights and heights x fertilizers effects were significant at the 1% level.

The mean dry weights of buffalo roots showed no significant effects due to either heights of clipping or rates of nitrogen fertilization (Tables 3 and 4). Basic data for dry weight of buffalo roots given in Table 18 show very little variation; the maximum variation in weight being 3 grams.

DISCUSSION

Climatic conditions during the season caused marked effects on the general appearance of the turf of both grasses. Abundant rains during May produced lush growth, but probably leached significant amounts of fertilizer from the soil. Dry and hot weather during the middle summer caused browning of the grasses, and benefitted the development of weeds and weedy grasses.

Yields of both grasses were affected by dates, heights of clipping, and fertilizers. Yield were highest from earliest clippings and declined during the summer. Clipping at 5/8 inch gave the highest yields, while yields were lowest on plots clipped at 2 inches. Forage yields increased with increased amounts of added nitrogen. Yields were inconsistent with different combinations of dates, heights, and fertilizers giving different results. Reduction in yield of the buffalo grass during the season was greater than the reduction in yield of bermuda grass. Plots of buffalo grass clipped at 2 inches became quite weedy during the months of August and September, with the clippings consisting largely of weedy material.

Average protein content of both grasses showed a marked decrease during the season. Protein content was highest on plots clipped at 5/8 inch, and decreased with greater clipping heights. Effects of added nitrogen were highly significant, with higher rates of fertilization increasing the protein content of both bermuda and buffalo grass. Weedy growth on some plots probably accounted for some of the decrease in protein content of buffalo grass in the last two clippings.

Ash content of both grasses was somewhat irregular during the season, and showed no effects due to heights of clipping. Addition of nitrogen showed inconsistent effects on the ash content of bermuda grass, but caused a slight and overall significant decrease in average ash content of buffalo grass.

Calcium content of both grasses showed only slight effects due to dates or heights of clipping. Addition of nitrogen caused little variation in calcium content of buffalo grass, and caused significantly different, but irregular effects on the calcium content of bermuda grass.

The effect of dates on the phosphorus content of bermuda grass was highly significant, and showed a tendency for a decrease during the summer. The average phosphorus content of buffalo grass varied only slightly and insignificantly during the season, with a tendency for a progressive decrease. Average phosphorus content of both grasses was highest on plots clipped at 5/8 inch, and decreased with greater clipping heights. The effects of nitrogen fertilizer were significant, with the addition of nitrogen showing an overall effect of decreasing the average phosphorus content. Phosphorus content of both grasses varied inversely with the calcium content.

The only effect of clipping heights and rates of nitrogen fertilization on root weights was noted in the case of bermuda grass. The effects of nitrogen showed significance at the 5% level, with the average weights highest on unfertilized plots. It is possible that any difference in root weights are to be noted in depth of penetration rather than in root mass near the soil surface. Greater differences may show up in later years.

The data reported by Stephens (18) for the first year of the current study varied to some extent from the results reported in this paper. Most differences can probably be attributed to differences in climatic conditions, which were somewhat more favorable in 1948. Average protein content of both bermuda grass and buffalo grass was slightly higher in 1948, attributable to a greater amount of rainfall during the summer. Ash, calcium, and phosphorus content in 1949 were slightly higher, and reflected the difference in precipitation between the two years. The yields of both grasses were higher in 1948 than in 1949, although the bermuda outyielded the buffalo grass by about the same proportion in both years. General appearance of the turf was affected by the same factors in both years: the addition of nitrogen imparted a more desirable, dark-green color; 1 inch clipping height produced the smoothest turf. In both seasons, weeds became more prevalent during the later clippings.

Measure of the interactions showed that the general response of both grasses for yield and chemical composition was not uniformily affected by the interacting effects of dates of clipping, heights of clipping, or rates of nitrogen fertilization. Accordingly, no certain height of clipping and rate of fertilizer combination gave consistently equal results; no certain rate of nitrogen fertilization was consistently better to the same degree for all dates; and no certain height of clipping gave equal results on all dates.

SUMMARY

In March, 1948, a 3-year experiment was initiated at the Oklahoma Experiment Station to study the effects of different dates, heights of clipping, and rates of nitrogen fertilization on the forage yields and chemical composition of bermuda grass and buffalo grass. Data presented in this paper is for the second year investigations, and does not justify making any definite conclusions. Data for 1949 show the following:

1. Appearance of the turf was enchanced by the addition of nitrogen, and the plots clipped at 1 inch maintained a better appearance throughout the season.
2. Weeds infested the low-clipped plots of bermuda grass and the high-clipped plots of buffalo grass.
3. Dry weight yields of forage of both grasses were highest on plots clipped at 5/8 inch, and lowest on plots clipped at 2 inches. Yields increased with increased amounts of ammonium nitrate, and were higher from early clippings. Total yields of bermuda grass were greater than total yields for buffalo grass.
4. Protein content of both bermuda grass and buffalo grass was highest on plots clipped at 5/8 inch, and progressively lower with higher clipping heights. Protein content was markedly affected by date of clipping, being highest in early cuttings and decreasing with subsequent cuttings. The addition of ammonium nitrate increased the protein content of both grasses.
5. Ash content was irregular during the season, and was slightly higher on plots clipped at 5/8 inch. The ash content of bermuda grass showed no definite response to added nitrogen, while the ash content of

buffalo grass varied inversely with the amount of nitrogen added.

6. The calcium content of both grasses fluctuated irregularly and was not greatly affected by dates, heights of clipping, or rates of nitrogen fertilization.

7. Phosphorus content of both grasses showed a slight decrease during the growing season, and was slightly greater on the plots clipped at 5/8 inch. Phosphorus content was affected slightly by the added nitrogen, the unfertilized plots being slightly higher than the fertilized plots.

8. Dry weights of roots of both grasses showed no marked response to any treatment, although bermuda roots showed slightly heavier weights on unfertilized plots.

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APPENDIX

Table 7.—Dry weight yields (pounds per acre) of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Repli- cation	Lbs. N per acre	Date of clipping					
			5/23	6/23	7/8	8/1	9/6	9/30
5/8"	I	0	348	443	836	180	494	207
		50	654	181	859	89	346	201
		100	368	442	877	569	445	268
		150	840	356	866	381	109	131
	II	0	876	256	698	444	318	174
		50	484	192	399	352	216	129
		100	568	270	615	252	106	107
		150	793	296	804	372	399	149
1"	I	0	137	219	413	218	97	61
		50	377	315	539	220	259	84
		100	850	794	765	368	183	73
		150	973	922	939	489	351	150
	II	0	298	219	735	312	504	265
		50	358	282	692	203	310	244
		100	660	392	1,028	375	397	240
		150	528	383	556	344	160	71
2"	I	0	395	281	442	299	256	40
		50	227	303	285	304	83	25
		100	204	459	479	364	221	56
		150	439	384	608	444	352	135
	II	0	123	252	466	253	294	107
		50	238	290	542	243	286	121
		100	135	213	447	335	347	99
		150	301	330	429	240	114	92

Table 8.—Percent protein content of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Repli-cation	Lbs. N per acre	Date of clipping 5/23	6/23	7/8	8/1	9/6	9/30
5/8"	I	0	15.81	14.13	14.48	14.60	10.71	11.15
		50	15.41	15.87	13.28	13.72	9.28	10.78
		100	16.80	16.57	15.10	11.65	13.16	12.41
		150	17.37	16.80	13.98	11.53	9.78	11.78
	II	0	15.17	15.99	13.22	11.34	16.35	11.09
		50	15.99	16.11	13.72	9.46	9.71	10.34
		100	14.66	15.99	13.16	10.53	9.46	11.03
		150	17.37	16.63	13.47	11.97	10.84	10.90
1"	I	0	17.38	14.19	13.28	9.84	8.58	10.09
		50	15.93	14.83	14.22	10.65	9.15	10.71
		100	13.61	15.76	14.79	11.46	11.03	10.71
		150	15.35	15.58	14.73	12.66	10.65	11.40
	II	0	13.44	15.93	14.60	14.03	10.65	12.10
		50	17.96	16.22	14.28	11.21	9.84	11.28
		100	11.87	15.53	13.53	11.40	10.21	9.71
		150	16.86	14.43	13.66	10.46	8.96	10.28
2"	I	0	14.94	13.90	13.22	10.84	9.40	9.65
		50	17.49	13.61	12.34	10.53	9.08	9.34
		100	18.59	15.06	13.28	12.09	10.84	10.15
		150	17.14	14.66	12.72	10.58	16.16	9.65
	II	0	15.70	16.22	13.66	11.21	9.65	9.35
		50	17.67	15.06	12.41	11.91	6.96	9.65
		100	14.66	17.74	13.47	12.03	10.21	10.15
		150	15.58	14.83	13.16	10.53	9.15	9.78

Table 9.—Percent ash content of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Repli-cation	Lbs. N per acre	Date of clipping					
			5/23	6/23	7/8	8/1	9/6	9/30
5/8"	I	0	4.43	11.85	13.16	13.47	9.32	13.43
		50	5.42	11.22	11.12	10.29	7.64	10.74
		100	6.49	11.56	11.90	10.65	9.06	11.91
		150	4.70	11.47	10.28	10.14	7.72	11.47
	II	0	5.47	11.95	13.14	11.27	9.68	14.41
		50	5.95	12.73	12.15	9.91	12.30	11.70
		100	4.99	12.14	11.27	9.78	7.29	10.52
		150	4.32	12.25	12.76	10.85	11.12	13.62
1"	I	0	4.73	10.65	10.28	9.16	7.50	10.32
		50	5.84	8.92	8.43	7.54	4.73	8.14
		100	5.03	11.46	10.95	10.85	8.85	11.79
		150	6.36	10.36	11.37	10.84	9.11	12.50
	II	0	4.24	11.19	11.16	9.65	11.13	13.27
		50	5.32	8.29	11.81	9.71	8.09	8.85
		100	4.69	11.16	13.62	11.43	9.14	16.08
		150	5.02	11.76	11.81	9.72	7.94	12.87
2"	I	0	6.29	9.99	10.06	9.48	10.54	12.40
		50	5.08	10.28	9.53	11.25	8.51	12.72
		100	4.44	10.64	10.97	10.15	10.98	12.51
		150	5.74	9.50	9.65	10.65	7.92	13.86
	II	0	4.69	10.29	13.66	9.38	8.54	13.27
		50	4.83	10.24	12.41	11.29	9.24	8.85
		100	4.37	10.97	12.03	10.49	11.12	16.08
		150	5.04	10.66	12.22	9.52	7.92	12.87

Table 10.—Percent calcium content of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. N per acre	5/23	6/23	7/8	8/1	9/6	9/30
5/8"	I	0	.41	.57	.51	.43	.45	.52
		50	.79	.50	.45	.47	.41	.51
		100	.79	.63	.42	.43	.40	.44
		150	.56	.48	.50	.53	.42	.52
	II	0	.63	.54	.49	.48	.45	.89
		50	.71	.92	.45	.51	.46	.58
		100	.52	.67	.50	.53	.44	.52
		150	.36	.80	.52	.48	.45	.63
1"	I	0	.47	.46	.48	.50	.41	.51
		50	.64	.38	.49	.51	.39	.51
		100	.41	.49	.47	.48	.48	.53
		150	.69	.38	.47	.44	.40	.61
	II	0	.43	.53	.49	.48	.51	.88
		50	.80	.56	.52	.53	.47	.77
		100	.39	.49	.49	.47	.56	.78
		150	.57	.49	.56	.51	.46	.75
2"	I	0	.75	.40	.45	.53	.50	.63
		50	.52	.39	.49	.51	.49	.59
		100	.43	.49	.48	.49	.51	.74
		150	.68	.48	.48	.56	.48	.65
	II	0	.45	.44	.44	.52	.49	.80
		50	.41	.45	.51	.52	.49	1.51
		100	.74	.68	.49	.54	.55	1.06
		150	.40	.51	.50	.55	.43	.66

Table 11.—Percent phosphorus content of bermuda grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. N per acre	Date of clipping 5/23	6/23	7/8	8/1	9/6	9/30
5/8"	I	0	.27	.49	.33	.39	.27	.33
		50	.27	.47	.29	.33	.22	.25
		100	.35	.47	.31	.28	.30	.30
		150	.32	.45	.28	.27	.21	.24
	II	0	.30	.49	.30	.28	.25	.25
		50	.29	.49	.28	.22	.23	.27
		100	.20	.47	.26	.24	.20	.25
		150	.25	.49	.26	.28	.27	.30
1"	I	0	.32	.46	.30	.27	.21	.18
		50	.32	.43	.29	.30	.21	.26
		100	.31	.46	.27	.28	.24	.25
		150	.35	.42	.30	.31	.27	.26
	II	0	.23	.42	.26	.26	.21	.20
		50	.26	.40	.26	.24	.19	.15
		100	.31	.49	.27	.26	.22	.17
		150	.20	.47	.24	.24	.19	.20
2"	I	0	.30	.42	.31	.27	.22	.21
		50	.24	.41	.26	.27	.21	.18
		100	.31	.42	.28	.26	.25	.22
		150	.33	.42	.28	.25	.22	.15
	II	0	.26	.45	.24	.24	.22	.23
		50	.29	.43	.26	.24	.20	.21
		100	.27	.38	.24	.22	.18	.24
		150	.27	.38	.25	.20	.18	.18

Table 12.—Dry weights (grams) of roots of bermuda grass as affected by different heights of clipping and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. of N per acre	Dry weight of roots (gms.)
5/8"	I	0	9
		50	12
		100	12
		150	9
	II	0	7
		50	10
		100	7
		150	9
1"	I	0	9
		50	8
		100	6
		150	13
	II	0	6
		50	8
		100	6
		150	13
2"	I	0	8
		50	10
		100	7
		150	7
	II	0	8
		50	9
		100	8
		150	8

Table 13.—Dry weight yields (pounds per acre) of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. of N per acre	Date of clipping 6/6	7/2	8/3	9/28
5/8"	I	0	273	399	103	77
		50	389	406	119	74
		100	476	563	120	75
		150	481	486	147	105
	II	0	297	405	190	75
		50	355	383	149	78
		100	419	518	184	147
		150	439	586	178	216
1"	I	0	252	275	35	72
		50	262	231	15	50
		100	357	185	19	44
		150	282	336	29	63
	II	0	189	182	39	58
		50	290	196	28	70
		100	259	315	56	101
		150	326	454	71	162
2"	I	0	12	17	24	26
		50	14	76	18	36
		100	25	33	17	96
		150	33	20	38	53
	II	0	34	47	18	44
		50	28	72	18	32
		100	115	240	30	56
		150	53	132	28	51

Table 14.—Percent protein content of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. of N per acre	6/6	7/2	8/3	9/28
5/8"	I	0	10.15	11.19	10.83	9.71
		50	11.15	11.41	10.89	10.59
		100	13.16	12.46	11.01	11.03
		150	13.97	12.92	12.05	9.02
	II	0	10.53	11.43	10.31	9.65
		50	11.09	11.47	11.00	11.40
		100	13.59	12.80	11.06	10.78
		150	13.78	12.74	12.23	10.15
1"	I	0	11.19	11.29	9.67	9.02
		50	11.59	9.56	9.79	9.15
		100	12.03	10.72	10.83	10.21
		150	13.47	12.46	10.95	10.40
	II	0	11.59	11.70	10.60	9.59
		50	11.71	11.47	8.86	9.21
		100	12.03	11.41	9.44	9.28
		150	13.66	12.39	11.36	10.09
2"	I	0	9.40	10.37	7.99	7.83
		50	11.34	10.72	10.31	7.77
		100	12.34	10.89	8.51	8.46
		150	13.47	11.36	8.57	8.58
	II	0	10.28	10.37	9.09	9.02
		50	10.59	17.26	12.34	8.46
		100	11.91	12.28	10.08	9.33
		150	12.84	13.09	11.41	8.71

Table 15.—Percent ash content of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Repli-cation	Lbs. of N per acre	Date of clipping 6/6	7/2	8/3	9/28
5/8"	I	0	7.71	9.15	7.36	8.64
		50	8.00	8.22	7.41	10.73
		100	7.52	8.80	6.70	10.80
		150	4.92	7.10	5.87	6.57
	II	0	8.66	8.81	7.40	10.19
		50	8.01	8.53	7.63	10.40
		100	8.21	9.00	7.20	9.35
		150	7.48	7.81	6.41	8.21
1"	I	0	8.55	8.49	7.08	9.08
		50	8.09	8.00	7.30	8.50
		100	7.59	5.46	5.05	8.14
		150	7.41	7.39	6.04	7.65
	II	0	9.10	8.77	7.43	11.49
		50	8.64	7.95	6.71	11.55
		100	7.23	7.80	6.29	12.01
		150	7.63	7.33	6.92	11.34
2"	I	0	9.62	8.30	6.98	7.65
		50	8.27	8.74	6.43	7.29
		100	7.60	7.84	6.66	7.23
		150	7.78	8.07	6.44	7.42
	II	0	8.28	7.36	5.96	6.64
		50	9.17	8.11	6.88	6.68
		100	7.65	7.69	6.03	7.70
		150	7.64	7.78	6.97	7.88

Table 16.—Percent calcium content of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. of N per acre	Date of clipping 6/6	7/2	8/3	9/28
5/8"	I	0	.62	.37	.61	.78
		50	.55	.32	.54	.86
		100	.50	.36	.61	.62
		150	.56	.41	.55	.55
	II	0	.60	.27	.46	.74
		50	.53	.36	.54	.76
		100	.69	.46	.55	.73
		150	.54	.32	.45	.67
1"	I	0	.58	.37	.48	.70
		50	.53	.36	.62	.74
		100	.49	.43	.55	.81
		150	.47	.32	.51	.82
	II	0	.52	.36	.46	.53
		50	.53	.35	.47	.62
		100	.51	.47	.57	.70
		150	.56	.33	.55	.63
2"	I	0	.80	.61	.58	.72
		50	.54	.45	.49	.67
		100	,58	.44	.56	.69
		150	.62	.59	.60	.71
	II	0	.50	.39	.69	.49
		50	.71	.57	.67	.59
		100	.44	.44	.59	.58
		150	.47	.50	.62	.45

Table 17.—Percent phosphorus content of buffalo grass as affected by different heights of clipping, dates of clipping, and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Repli-cation	Lbs. of N per acre	Date of clipping 6/6	7/2	8/3	9/28
5/8"	I	0	.14	.16	.14	.14
		50	.14	.14	.16	.25
		100	.13	.14	.15	.14
		150	.13	.12	.14	.13
	II	0	.14	.15	.15	.16
		50	.14	.15	.16	.17
		100	.13	.15	.16	.16
		150	.13	.14	.13	.14
1"	I	0	.16	.15	.13	.15
		50	.14	.14	.15	.13
		100	.14	.14	.14	.14
		150	.14	.14	.13	.14
	II	0	.16	.15	.15	.15
		50	.13	.14	.13	.12
		100	.13	.15	.14	.14
		150	.14	.14	.14	.13
2"	I	0	.14	.14	.11	.12
		50	.15	.14	.14	.11
		100	.14	.15	.12	.10
		150	.15	.13	.11	.11
	II	0	.14	.14	.12	.10
		50	.13	.13	.14	.13
		100	.14	.14	.12	.13
		150	.14	.15	.14	.13

Table 18.—Dry weights (grams) of roots of buffalo grass as affected by different heights of clipping and rates of nitrogen fertilization, Stillwater, 1949.

Height of Clipping	Replication	Lbs. of N per acre	Dry weight of roots (gms.)
5/8"	I	0	7
		50	5
		100	7
		150	4
	II	0	4
		50	5
		100	4
		150	5
1"	I	0	5
		50	6
		100	4
		150	4
	II	0	6
		50	6
		100	5
		150	8
2"	I	0	5
		50	3
		100	5
		150	4
	II	0	7
		50	4
		100	4
		150	4

May 15, 1950

George Alva Niles Student

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Title of Study: Effect of different heights of clipping, rates of nitrogen fertilization, and dates of clipping on yield, chemical composition, and root production of bermuda grass, Cynodon dactylon (L.) Pers., and buffalo grass, Buchloe dactyloides, (Nutt.) Engelm.

42 Pages in Study

Under direction of Agronomy Department

Scope of Study: Both bermuda grass and buffalo grass are well adapted to Oklahoma conditions, and have proven to be good grasses both for turf purposes and for livestock pastures and feed. However, little specific information is available on the variations in yield and chemical composition of the grasses. It was the purpose of this study to investigate the effects of different heights and dates of clipping, and rates of nitrogen fertilization, on the yields, chemical composition, and root production of bermuda and buffalo grass. Three clipping heights were used: 5/8, 1, and 2 inches. Six clippings were made on the bermuda gras and four on the buffalo grass and gave a measure of seasonal variation in yield and chemical composition. Ammonium nitrate was applied at rates of 0, 50, 100, and 150 pounds of nitrogen per acre. Dry weight yields were taken, and chemical analyses conducted to determine percentages of protein, ash, calcium, and phosphorus for both grasses. Root samples were taken to determine the variation in root production. Analyses of variance were made to measure differences between treatments, and assign significance or non-significance to various treatment effects.

Findings and conclusions: The data reported is for 1949 and the second year of a 3-year study. Addition of nitrogenous fertilizer effected an immediate improvement in the color of the turf of both grasses. During the months of May and June the grasses had a fine appearance, but became browned during the summer when precipitation was low. In addition, weeds and weedy grasses invaded the high-clipped plots of buffalo grass and the low-clipped plots of bermuda grass. Clipping at 5/8 inch resulted in the highest yields, highest percentages of protein, and highest percentages of phosphorus. Ash and calcium content of both grasses were only slightly affected by clipping height. Clippings made early in the season gave the highest yields, highest protein content, and highest phosphorus content for both grasses. Ash and calcium content were not greatly affected by the date of clipping. The addition of ammonium nitrate increased forage yields and protein content of both grasses. Ash content of bermuda grass showed no definite response to nitrogen, while ash content of buffalo grass varied inversely with the amount of nitrogen added. Addition of nitrogen did not greatly affect calcium or phosphorus content of either grass. Dry weights of roots of both grasses showed no marked response to any treatment, although bermuda grass roots showed slightly heavier weights on unfertilized plots. The data reported does not justify making and specific recommendations.

Approved by chairman of thesis committee: M. D. Jones

TYPED BY: PAULINE NILES