THE RELATIVE NUTRITIVE VALUE OF SUDO AND SORGO SILAGES

by

THOMAS EARL SHULTZ

B. S., University of New Hampshire, 1954

A MASTER'S THESIS

submitted in partial fulfillment of the

requirement for the degree

MASTER OF SCIENCE

Department of Dairy Husbandry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1961

TABLE OF CONTENTS

INTRODUCTION

The ability or opportunity to grow hay-crop roughage is somewhat restricted in areas receiving varied amounts of rainfall, such as the middle and southwest parts of our country. Sorghums and Sudan grass are summer annuals which can tolerate periods of hot, dry weather. These forages were first introduced to America from France in 1855 and have since been vital to forage plans in the Great Plains states. Sorghums can be made into excellent quality silage provided they are harvested at the right stage of maturity and are ensiled properly. In addition to being adapted to areas that could not grow corn advantageously, the sorghums yield up to 50 percent more tonnage per acre than does corn; granted, however, that corn is richer in protein and digestible nutrients.

Sorghum growers and animal feeders are interested in planting the variety of sorghum which will contribute to the greatest profit from the whole farming enterprise. Farm profit is dependent on large agronomic yields in combination with efficient animal utilization, a function of feed intake and nutrient availability. Sorghum varieties of several distinct types are available for planting. These range from the grain type, short and heavily seeded, through the forage type, tall and moderately seeded, to the hybrids of Sudan grass and sorghum parentage which are relatively poorly seeded but produce large tonnages. Many of the seeds in sorghum silage pass through the digestive tracts of cattle incompletely digested. Since sorghums which

yield much dry matter and little seed are available, the desirability of planting heavily seeded types is subject to question.

This study was designed to compare "Sudo," a lightly seeded hybrid of Sudan grass and forage sorghum parentage, and Atlas sorgo silage as roughages for growing dairy heifers.

REVIEW OF LITERATURE

Considerable research has been conducted comparing the relative nutritive value of corn and sorgo silages. Beef steers and lactating dairy cows have been used primarily in these studies. Comparatively little work has been done with sorgo silage as the only roughage for growing dairy heifers. A few studies have compared the sorghum silages differing in seed content.

The adaptability of a crop to an area is a deciding factor in its use. Thus, the sorghums are ideal for Kansas. Sorghums, developed in Africa and southern Asia, are adapted to high temperatures and variation in rainfall, 16-40 inches per year in Kansas (Mohler, 1948). Sorghums, can remain dormant during long, dry periods and yet recover quickly with light rainfall late in the season (Wheeler, 1950). In addition, sorghums are resistant to cinch bugs and grasshoppers and adapt to soils ranging from light and sandy to heavy clay-loam. These attributes of the sorghums make them good insurance against dry seasons which occur periodically in the Great Plains states.

When other crops fail, sorghums can be counted on (Atkeson et al., 1939). However, Atkeson et al. (1945) found that production decreased from lactation to lactation when cows were on a strictly milo grain and sorgo silage ration. On the above ration animals became thin and acquired an unthifty appearance.

The literature is in general agreement that corn silage is somewhat more efficient than sorghum for the production of meat and milk, in spite of the fact that the sorghums outyield corn. Good et al. (1921) found that in addition to the fact that sorgo silage was only 72 percent as efficient, it was 92 percent as economical as corn silage, if cost of harvest, feed supplementation and quality of carcass were considered. However, more beef can be produced per acre with sorghum by virtue of its greater yields. Work at Mississippi (Goddell, 1924) showed that steers gained 1.85 and 2.07 pounds per day on rations of sorgo and corn silage, respectively. At the Kentucky station, Good et al. (1921) found that feeder steers gained 1.70 pounds and 2.19 pounds per day on sorgo and corn silage, respectively. These silages were supplemented with cottonseed meal and ground ear corn. Quesenberry (1925) concluded that sorgo silage compared favorably with corn silage when the amount of protein supplement was increased during the last fifty days of feeding. During two different seasons, steers gained 2.07 and 1.90 pounds per day on this supplemented sorgo ration while gaining 1.75 and 1.98 pounds on a similarly

supplemented corn silage ration. The dry matter intake was comparable for these silages. Buchaman (1930) also reported larger gains with corn silage in the ration as compared with those fed sorgo silage. Gerlaugh and Rogers (1945) found that the carcass quality of steers finished on sorgo silage was inferior to that of animals finished on corn silage. King (1944) stated that finish and dressing percentage favored steers fattened on corn silage. On the other hand, Bell et al. (1919) and Cunningham and Reed (1927) found that sorgo silage was more palatable than corn silage.

Morrison (1956) estimates that sweet sorghum contains 15.2 percent total digestible nutrients. However, it has been found that some of the sorghum seeds pass through the alimentary tract intact and are voided in the feces in considerable amounts. Reed and Fitch (1911) reported that a large portion of the kafir seed passed through the digestive tract intact. In this work kafir silage was slightly inferior to corn silage as part of a ration for lactating cows. Becker and Gallup (1927) found that one third of the grain in sorgo silage was voided in the feces. Chemical analyses indicated that only a small amounts of the ether extract and crude protein in the seed were utilized. The difference in nutritive value between sorgo and corn silages was explained by the difference in seed voided--27 and 2 percent, respectively. La Master and Morrow (1929) and Becker and Gallup (1927) suggested that heads should be harvested before ensiling, provided the cost of labor and

machinery was not prohibitive. At the Nebraska station corn silage and two sorghums, Axtell and RS 303F, heavily and lightly seeded, respectively, were compared with regard to their nutritive value in a ration for milk production (Owen, et al. 1959). Cows fed corn silage produced 2.1 pounds more milk per day than those on either of the sorghums. There was no significant difference in dry matter intake, body weight gain, butterfat in the milk produced among treatments. These workers concluded that the lightly seeded sorghum silage was practically as nutritious as the heavily seeded forage.

The stage of maturity at harvest influences the nutritive value and palatability of silages. Cows produced more 4 percent fat corrected milk when fed Tracy sorghum harvested in the soft dough stage than when fed silage harvested in the hard seed state (Leighton and Rupel, 1959). The immature silage contained 23.5 percent total digestible nutrients and the mature silage 18.5 percent. There was little difference in dry matter content. Helm and Leighton (1960) reported similar results. Digestibility of sorghum silage decreased with advancing stages of maturity at harvest. Cows preferred the less mature silage and produced more milk when it was fed.

It was found by Reed and Fitch (1911) that sorgo silage, harvested when the moisture content was high, was more sour. These workers recommended that sorgo be harvested at least three weeks after the correct corn silage harvest stage. Obviously, this would depend on the variety planted. Further,

these workers stated that it is better to ensile frosted rather than immature sorghum. In work done at the Kansas station, Atkeson and co-workers (1943) found that when the fermentation temperature is too high, due to forage being too dry at harvest, brown silage resulted. Superior silage, containing more total digestible nutrients, can be made at lower temperatures. High temperature fermentation results in nutrient loss especially in crude protein and dry matter (Craigmiles et al., date unknown). The dry matter loss at high fermentation temperatures is twice that of silage ensiled at the correct stage of maturity.

The relative nutritive value of sorgo and corn silages has been compared for use in the ration of lactating cows. Cows ate more sorgo silage yet they produced, during two trials, 1.5 and 1.7 percent more milk, 4.3 and 2.9 percent more butterfat where the ration contained corn silage (Cunningham and Reed, 1927). On the basis of quantity consumed, sorgo silage produced 91.1 and 95.8 percent as much milk, during two trials as did corn silage. Wolk and Voorhies (1917) found that cows fed corn silage as part of the ration for milking cows, returned 64.9 pounds of milk per 100 pounds dry matter consumed, whereas those fed Sudan grass silage returned 58.3 pounds of milk per 100 pounds dry matter. The nutritive ratios of the two silages were nearly the same. Those cows fed corn silage consumed more silage and less hay than the Sudan grass-fed group. Reed

and Fitch (1911) reported that cows declined in milk and butterfat production when changed from corn silage to sorgo silage. It was suggested by these workers that sorgo silage is more fattening than corn silage, accounting for an increase in body weight. Equal amounts of concentrates and hay were fed to both groups. It was also found that a large proportion of the sorgo grain passed through the digestive tract undigested. Cows fed corn silage consumed more silage, gained more weight ($P < .05$) and produced more 4 percent fat corrected milk ($P < .01$) than did those fed a ration containing sorgo silage (Owen et al., 1957). It was found that cows fed sorgo silage tended to have a higher incidence of off-flavor milk. At the South Carolina station it was found that, while cows fed sorgo silage consumed more silage, hay and grain than those fed corn silage, there was no significant difference in either milk or butterfat production (La Master and Morrow, 1929). During a 30-day period, the sorgo silage cows gained slightly more weight. According to these workers one pound of corn silage is equivalent to 1.38 pounds of sorgo silage as part of a ration for lactation and is 75 per cent as efficient as corn silage expressed on a total digestible nutrient basis. The lower efficiency of sorgo silage can be explained partially by the fact that these workers recovered 27.6 percent of the sorgo grain in the feces as compared to 1.9 percent of the corn grain.

Dry matter consumption is a critical factor where silage constitutes a large portion of the ration. Workers at the New

Hampshire station (Keener et al, 1958) found that when hay was fed, heifers consumed 20.3 percent more energy and 23.8 percent more protein and gained 16 percent more weight when hay was included in the ration at the rate of 0.75 pound per 100 pounds body weight with grass silage than when grass silage was fed alone. Those animals on grass silage and limited hay made gains which averaged 94 percent of Morrisons standard (1956), whereas heifers on the other ration made less satisfactory gains. Further, it was found that Guernsey heifers grew at a more nearly normal rate than did the Holsteins and that, over a two year period, Guernseys consumed the same amount of roughage as did the Holsteins.

Thomas et al. (1959) stated that heifers fed alfalfa and corn silage gained less weight than those fed hay. Addition of one pound of hay per 100 pounds body weight or two pounds of grain daily to the silage ration resulted in nearly normal rates of growth. Rates of growth were parallel to dry matter consumption for the different rations. Those heifers fed alfalfa hay alone gained 1.46 pounds per day. Jersey heifers on an all silage ration gained 0.68 pound per day. While on alfalfa hay they gained 0.88 pound per day, well above the normal growth rate. Dry matter consumption decreased 3 pounds per day when the ration was changed from hay to silage at one year of age (Thomas, 1959). Hay crop silage supplemented with grain or hay can be fed to grow heifers successfully past one year of age. From 8 to 12

months of age, alfalfa silage supplemented with grain produced greater gains than those made on an alfalfa hay ration, although, the difference was insignificant (Thomas, et al. 1959). Cave et al. (1924) found alfalfa hay and grain obtained better results than silage and hay or hay alone.

The literature on the nutritive value of sorgo silages is somewhat indefinite but some relationships appear to be strongly suggested. There is definite correlation between stage of maturity at harvest, silage quality and nutritive value. The factor which limits the value of silages for growing heifers is dry matter intake. The lower efficiency of the sorghums is probably due to the large portion of seeds voided in the feces. For this reason, some lightly seeded silages are nearly as nutritious as those which are heavily seeded. Forage harvested at immature stage of maturity results in sour, unpalatable silage containing too little dry matter.

PROCEDURE

The silages used in this experiment were made from heavily seeded Atlas sorgo and Sudo, a lightly seeded hybrid of Sudan grass and a forage sorghum. The well seeded Atlas was harvested in 1957 at the hard dough stage of maturity. The lightly seeded Sudo was harvested in 1958 at the soft dough stage of maturity. Both silages were stored in concrete-stave, upright silos.

Table 1. Composition of experimental groups.

Animal	Breed	Age at start	Date bred
Sudo		months	
54B	Grade	13	open
173C	Holstein	17	open
176C	Holstein	16	1-29-60
178C	Holstein	13	open
228C	Ayrshire	17	1-8-60
229C	Ayrshire	16	12-14-59
367C	Jersey	16	open
370C	Jersey	16	open
485C	Guernsey	18	1-8-60
Sorgo			
46B	Grade	20	3-21-60
49B	Grade	16	open
53B	Grade	13	open
171C	Holstein	17	1-11-60
175C	Holstein	16	open
179C	Holstein	12	open
227C	Ayrshire	17	11-28-59
368C	Jersey	16	2-16-50
371C	Jersey	13	open

Eighteen dairy heifers ranging in age from eleven to nineteen months were used in this experiment (Table 1). Most of these heifers were open; however, those of breeding age and size were bred during the trial. None was sufficiently advanced in gestation to influence feed consumption or body weight during this trial.

Prior to this experiment these heifers had been receiving hay and silage ad libitum together with a small quantity of grain. During the experiment two pounds of ground corn and two pounds of soybean oil meal were fed daily to each heifer. The same amount was fed to all heifers in the belief that the small heifers would need the extra proportion of dry matter to maintain desirable rates of growth. Having had silage prior to the trial, these animals were accustomed to this feed.

The animals were divided into two groups of nine according to breed, age and size. One group was fed Atlas sorgo silage and the other was fed Sudo silage as the only roughage for 70 days.

The heifers were housed in a stanchion barn and fed in mangers having tight partitions. They had access to water at all times and were turned out for exercise each day. The stalls were bedded with wood shavings.

One week was utilized as an adjustment period, enabling the animals to become familiar with the surroundings. During this time, they were fed the rations to be used during the trial.

The animals were weighed on two consecutive days prior to the start of the trial and weighed each fourteenth and fifteenth days thereafter for the duration of the experiment.

Animals were fed once daily, in the forenoon, more silage than they could consume in order that ad libitum consumption could be determined by measuring the amount refused.

Twice each week a composite, random sample of silage was taken from each silo. Proximate analyses were made on these samples. Dry matter and pH were determined on each silage twice each week.

RESULTS

The proximate composition and pH of the silages used in this experiment are presented in Table 2.

Table 2. Chemical composition of silages (dry basis).

Silage	Dry Matter	Crude Protein	Ether Extract	Crude Fiber	Nitrogen-Free extract	Ash	pH
	%	%	%	%	%	%	
Sudo	25.1	9.3	2.1	28.7	50.9	9.0	4.17
Sorgo	24.5	7.4	2.4	26.8	54.9	8.5	4.24
P	n.s*	0.001	0.1	n.s	0.1	n.s	n.s

* Not significant

The Sudo silage had somewhat more crude protein, slightly more crude fiber and less nitrogen-free extract than did the sorgo silage. Chemical analyses of individual samples are presented in Table 5 in the appendix. A summary of feed consump-

Table 3. Dry matter consumption.

Animal	Silage D.M. Consumption	Total D.M. Consumption	D.M. Consumption per 100 lb.
Sudo	lb./day	lb./day	lb./day
54B	7.5	11.1	1.63
173C	12.4	16.0	1.72
176C	10.9	14.5	1.75
178C	7.5	11.1	1.76
228C	10.7	14.3	1.83
229C	7.7	11.3	1.55
367C	5.4	9.0	1.36
370C	5.0	8.6	1.59
485B	8.2	11.8	1.64
		ave.	1.65
Sorgo			
46B	6.8	10.4	1.76
49B	8.6	12.2	1.36
53B	5.6	9.2	1.64
171C	6.7	10.3	1.35
175C	10.1	13.7	1.63
179C	9.0	12.6	1.73
227C	9.6	13.2	1.71
368C	5.1	8.7	1.47
371C	6.7	10.3	1.80
		ave.	1.61

tion of individual animals for the entire experiment is presented in Table 3. Dry matter consumption of individual animals by periods is presented in Table 7a-7e in the appendix.

Total dry matter consumption, including silage, corn and soybean oil meal per unit of body weight was slightly greater for the group fed the Sudo silage than for that fed the Atlas sorgo silage ($P < 0.25$). However, the dry matter intake of both groups was less than optimal and varied considerably among individuals.

A comparison of body weight and daily gains of individual animals with those of Morrison's (1956) standard is presented in Table 4. Weight gains by periods are presented in Table 6 in the appendix. Weight gains of both groups of heifers were slightly below Morrison's (1956) standard. The average gains of animals within each group were practically the same. The sorgo silage group utilized their feed more efficiently than did the Sudo silage group as shown by the greater dry matter intake required by the Sudo silage group for approximately the same rate of weight gain.

Increased silage consumption up to and including the third period followed by a decline during the remaining two periods was concurrent with a drop in mean environmental temperature followed by a rise in temperature. Larger amounts of silage were consumed during the colder third period. Body weight gains were greater during the period of peak silage consumption.

Table 4. Body weights and rates of gain compared with a standard.

Animal	Breed	Start Body Weight	Std.*	Finish Body Weight	Std.*	Rate of gain Expt.	Std.*
		lb.	lb.	lb.	lb.	lb./day	lb./day
Sudo							
54B	GH	664	719	714	799	0.72	1.15
173C	H	892	855	966	935	1.06	1.15
176C	H	779	820	856	900	1.10	1.15
178C	H	579	719	688	799	1.56	1.15
228C	A	746	663	812	726	0.94	0.90
229C	A	697	635	761	698	0.91	0.79
367C	J	651	597	719	652	0.97	0.79
370C	J	524	597	557	652	0.47	0.79
485B	G	689	663	737	726	0.69	0.90
	ave.	691	696	757	765	0.94	0.99
Sorgo							
46B	GJ	571	694	600	749	0.41	0.79
49B	GH	843	820	952	900	1.55	1.15
53B	GH	543	719	608	799	0.93	1.15
171C	H	757	855	789	935	0.46	1.15
175C	H	788	820	870	900	1.17	1.15
179C	H	679	685	760	765	1.16	1.15
227C	A	685	663	817	726	1.89	0.90
368C	J	577	597	584	652	0.10	0.79
371C	J	549	522	603	577	0.78	0.79
	ave.	666	708	731	778	0.94	1.00

* Morrison (1956) p. 680

DISCUSSION

The difference in proximate composition between the Sudo and sorgo silages is attributable to one or more of several factors. Among these are inherent composition of the individual varieties, the relative proportion of seed in the forages and the stage of maturity at harvest. Morrison (1956) indicated that the protein content of Sudan grass silage was somewhat greater than that of sorgo silages. The Sudan grass parentage may be the cause of a portion of the difference in protein content of the silages used in this study. The difference in protein content of the two silages is in the wrong direction to be answered with the difference in seed content since the protein content of sorghum seed is ordinarily greater than that of the whole plant. The greater seed content of the sorgo silage is indicated by its greater proportion of nitrogen-free extract.

The dry matter consumption of the animals in this experiment was inadequate to support growth rates equal to Morrison's (1956) standard. Ground corn and soybean oil meal were fed in the same amounts regardless of heifer size in anticipation of the probable inability of small heifers to consume sufficient silage to support normal rates of growth. The mediocre rates of growth demonstrate the need for this supplementation. Protein sufficiency of the ration was insured by the two pounds soybean oil meal. Thomas et al, (1959) demonstrated the inability of heifers to consume enough haycrop silage to

support normal rates of growth. The difficulty encountered in this experiment may be of a like nature-too little dry matter consumption when silage comprises the entire roughage portion of the ration.

The slightly greater feed intake of heifers fed Sudo silage with about the same rate of growth as those fed sorgo silage indicates that the Sudo silage was utilized less efficiently and was somewhat lower in nutritive value than the sorgo silage.

This does not appear to be in agreement with the results reported by Owen et al. (1959) in which lightly seeded sorgo silage was as nutritious as heavily seeded silage. This may have been due to the difference in the lightly seeded hybrids used in these experiments. Obviously, silages made from the same variety might vary with season, soil fertility, stage of maturity at harvest and efficiency of storage.

The variation in feed intake among experimental periods may have been due to difference in the environmental temperature during the periods. The average "mean" temperatures during the five periods were 35.5°, 21.5°, 15.6°, 26.4° and 50.5°F., respectively. The animals consumed less silage during the periods with higher "mean" temperatures.

The results of this experiment indicate that dairy heifers are relatively poor indicators of the nutritive value of sorgo silage because of their meager silage consumption. Within the limits of this trial and disregarding agronomic consider-

ations, Sudo silage is slightly less nutritious than Atlas sorgo silage for dairy heifers.

SUMMARY

Growth of dairy heifers was used to determine the relative nutritive value of two silages. The silages were made from heavily seeded Atlas sorgo forage and lightly seeded Sudo forage. The silages were fed ad libitum, each to a group of nine heifers. Two pounds each of ground corn and soybean meal were fed to each heifer daily. Silage was fed once daily in quantities to insure some refusal. The trial was conducted over a 10-week period.

The Sudo silage contained somewhat more crude protein, slightly more crude fiber and less nitrogen-free extract than did the sorgo silage. The heifers which were fed the Sudo silage consumed slightly more ($P < 0.25$) total dry matter, 1.65 pounds per hundred pounds, than did the Atlas silage group, 1.61. Average rates of growth were the same for both the Sudo and sorgo groups, 0.94 pound per day. The low intake of silage by the heifers and its relationship to the mediocre rates of growth were discussed.

The results of this experiment indicate that dairy heifers consume too little sorgo silage to make adequate gains in body weight, even when supplemented with four pounds of concentrate daily. The fact that the Sudo silage was consumed in slightly greater quantities and yet produced

no better gains than Atlas sorgo silage indicates that Sudo silage is slightly inferior in nutritive value.

ACKNOWLEDGMENTS

The writer wishes to express his sincere appreciation to Dr. George M. Ward for his aid in planning and conducting this experiment and for his patience, constructive criticisms and guidance in preparing this manuscript.

Appreciation is also extended to Dr. Charles L. Norton, Head, Department of Dairy Husbandry for making this study possible as well as to members of the Advisory Committee for their guidance during this course of study.

LITERATURE CITED

Atkeson, F. W., W. H. Riddell, W. J. Peterson and W. W. Thompson.
A field study of the influence of restricted winter rations on the blood calcium, phosphorous and carotene of dairy cattle. (abstract) J. Dairy Sci. 22: 459-460. 1939.

Atkeson, F. W., H. E. Bechtel, J. S. Hughes.
Brown silage from Atlas Sorgo- chemical composition and apparent digestibility as determined by feeding to dairy cows. J. Animal Sci. 2: 295. 1943.

Atkeson, F. W., H. E. Bechtel, W. J. Peterson, W. W. Thompson, J. S. Hughes and Marvin Koger.
Sorghum feeds for dairy cattle. J. Dairy Sci. 28: 531-544. 1945.

Becker, R. B. and W. D. Gallup.
Utilization of grain in Kafir and Cane silage by dairy cows. Okal. Agr. Expt. Sta. Bul. 164: 3-7. 1927.

Bell, F. W., H. B. Winchester, C. W. Mc Campbell.
Corn silage versus sorgo silage in fattening baby beef. Kans. Agr. Expt. Sta. Cir. 77. 1919.

Buchanan, D. S.
Comparisons of roughages for finishing steers. Miss. Agr. Expt. Sta. Bul. 278: 2-11. 1930.

Cave, H. W., O. E. Reed and J. B. Fitch.
Relation of feeding and age of calving to the development of dairy heifers. Kans. Agr. Expt. Sta. Bul. 233: 1924.

Craigmiles, J. P., J. P. Newton and J. E. Bailey.
Sorgo for silage. Ga. Agr. Expt. Sta. Leaf. 19. date unknown.

Cunningham, W. S. and J. B. Reed.
Sorgo versus corn silage for milk product. Ariz. Agr. Expt. Sta. Bul. 122: 143-155. 1927.

Goddell, C. J.
Steer feeding-corn versus sorghum silage. Miss Agr. Expt. Sta. Bul. 222: 3-16. 1924.

Good, E. S., L. J. Horlacher and J. C. Grimes.
A comparison of corn silage and sorghum silage for fattening steers. Ken. Agr. Expt. Sta. Bul. 233: 61-89. 1921.

Helm, R. E. and R. E. Leighton.
Relationship of stage of maturity at harvest to the feeding value of sorghum silage for dairy cows. (abstract) J. Dairy Sci. 43: 868. 1960.

Keener, H. A., F. E. Allen, N. F. Colovos, Ann C. Paul and H. A. Davis.
Value of adding corn silage and limited quantities of hay to a grass silage limited grain ration for dairy heifers. J. Dairy Sci. 41: 429-437. 1958.

King, F. G.
Atlas sorgo silage for fattening cattle. Ind. Agr. Expt. Sta. Bul. 500: 3-11. 1944.

La Master, J. P., and K. S. Morrow.
Corn silage versus sweet sorghum silage for milk production. S. Car. Agr. Expt. Sta. Bul. 254: 5-32. 1929.

Leighton, R. E. and I. W. Rupel.
Value of Tracy Sorghum cut at two stages of maturity for feeding producing dairy cattle. (abstract) J. Dairy Sci. 42: 393. 1959.

Mohler, J. C.
Climate of Kansas. Report of Kansas State Board of Agr. pp. 2-4. 1948.

Morrison, F. B.
Feeds and Feeding, 22nd ed. Morrison Pub. Co. Ithaca, N. Y. pp. 168-188, 657-681. 1956.

Owen, F. G., J. R. Kiuken and O. J. Webster.
Comparative value of forage sorghums and corn as silages for lactating cows. (abstract) J. Dairy Sci. 42: 930. 1959.

Owen, J. R., J. T.Miles, W. S. Cowsert, J. W. Lusk, E. W. Custer, and J. T. Cardwell.
Feeding values of corn and sorghum silage for milk production. J. Dairy Sci. 40: 1554-1558. 1957.

Quesenberry, J. R.
Steer Feeding in the sugar cane belt. U. S. D. A. Bul. 1318: 1-13. 1925.

Reed, O. E. and J. B. Fitch.
Sorghum crops for silage. Kans. Agr. Expt. Sta. Bul. 28: 1-6. 1911.

Rogers, C. F., and Peter Gerlaugh.
Sorgo silage. Ohio Agr. Expt. Sta. Bul. 659: 56. 1945.

Thomas, J. W.
Further comparisons of alfalfa hay and alfalfa silage for growing dairy heifers. (abstract) J. Dairy Sci. 42: 929. 1959.

Thomas, J. W., J. F. Sykes and L. A. Moore.
Comparison of alfalfa hay and alfalfa silage alone and with supplements of grain, hay or corn silage for growing dairy calves. J. Dairy Sci. 42: 651-657. 1959.

Wheeler, W. A.
Forage and Pasture Crops. D. Van Nostrand Pub. Co. New York. pp. 631-644. 1950.

Woll, F. W. and E. C. Voorhies.
Trials with California silage crops for dairy cows. Cal. Agr. Expt. Sta. Bul. 282: 19-40. 1917.

APPENDIX

Table 5. Chemical analyses of individual silage samples. (dry basis)

Period	1	2	3	4	5
Sudo					
Dry matter -%	25.2	23.4	27.0	24.4	25.6
Crude protein-%	9.4	9.3	9.4	9.2	9.6
Ether extract-%	2.1	2.0	2.3	2.1	2.1
Crude fiber -%	29.5	31.1	27.9	27.7	27.2
Nitrogen-free extract -%	50.2	47.7	51.6	52.7	52.3
Ash -%	9.4	9.9	8.8	8.3	8.8
Sorgo					
Dry matter -%	24.5	25.1	24.0	23.9	25.0
Crude protein-%	7.4	7.3	7.4	7.6	7.5
Ether extract-%	2.3	2.2	2.5	2.5	2.2
Crude fiber -%	27.2	26.8	27.6	27.1	25.3
Nitrogen-free extract -%	54.6	55.3	53.9	54.2	56.6
Ash -%	8.5	8.4	8.6	8.6	8.4

Table 6. Daily weight gain by periods.

Period	:1	:2	:3	:4	:5	:Ave.
Sudo	:lb./day	:lb./day	:lb./day	:lb./day	:lb./day	:lb./day
54B	.25	0.04	1.93	-0.64	2.00	.72
173C	1.28	0.50	1.71	1.57	0.25	1.06
176C	2.29	1.54	0.79	- .68	1.57	1.10
178C	0.46	1.75	2.18	0.64	2.75	1.56
228C	1.21	-0.39	3.71	-2.00	2.18	.94
229C	1.61	0.07	1.89	-1.46	2.43	.91
367C	-0.39	0.57	-0.04	2.14	2.57	.97
370C	0.57	0.29	1.54	-0.46	0.43	.47
485C	0.85	0.46	1.18	0.54	0.39	.69
						ave. .94
Sorgo						
46B	.46	1.00	2.36	-2.50	.71	.41
49B	1.50	1.21	2.07	- .97	3.93	1.55
53B	- .04	- .07	1.78	.39	2.61	.94
171C	- .32	.71	2.14	-1.11	.89	.46
175C	.46	1.89	3.21	1.00	- .71	1.17
179C	.79	1.11	3.32	.54	.07	1.16
227C	3.71	.96	2.54	.96	1.25	1.89
368C	- .11	.82	1.82	- .75	-1.29	.10
371C	- .82	.96	1.82	.68	1.25	.78
						ave. .94

Table 7a. Feed consumption-Period 1

	Silage D. M. consumption	Total D. M. consumption	D. M. consumption
Sudo	lb./day	lb./day	lb./cwt.
54B	7.1	10.7	1.61
173C	11.5	15.1	1.68
176C	11.1	14.7	1.85
178C	5.8	9.4	1.62
228C	9.0	12.6	1.66
229C	7.6	11.2	1.58
367C	5.3	8.9	1.37
370C	5.0	8.6	1.63
485B	7.9	11.5	1.65
			ave. 1.63
Sorgo			
46B	7.0	10.6	1.84
49B	7.4	11.0	1.29
53B	4.4	8.0	1.47
171C	5.8	9.4	1.25
175C	8.4	12.0	1.51
179C	7.8	11.4	1.66
227C	7.6	11.2	1.57
368C	4.5	8.1	1.40
371C	6.1	9.7	1.79
			ave. 1.53

Table 7b. Feed consumption--Period 2

	Silage D. M. consumption	Total D. M. consumption	D. M. consumption
Sudo	lb./day	lb./day	lb./day
54B	7.0	10.6	1.59
173C	10.9	14.5	1.59
176C	10.2	13.8	1.68
178C	6.9	10.5	1.75
228C	8.8	12.4	1.63
229C	6.9	10.5	1.44
367C	5.1	8.7	1.34
370C	4.8	8.4	1.57
485C	7.4	11.0	1.56
			ave. 1.57
Sorgo			
46B	7.2	10.8	1.85
49B	9.1	12.7	1.45
53B	5.1	8.7	1.61
171C	6.4	10.0	1.32
175C	10.5	14.1	1.75
179C	9.3	12.9	1.85
227C	10.0	13.6	1.83
368C	4.7	8.3	1.43
371C	6.5	10.1	1.87
			ave. 1.66

Table 7c. Feed consumption--Period 3

	Silage D.M. consumption	Total D. M. consumption	D. M. consumption
	lb./day	lb./day	lb./cwt.
Sudo 54B	8.9	12.5	1.81
173C	12.6	16.2	1.74
176C	12.8	16.4	2.00
178C	9.0	12.6	1.99
228C	13.6	17.2	2.21
229C	9.8	13.4	1.84
367C	6.5	10.1	1.47
370C	6.2	9.8	1.81
485C	10.3	13.9	1.95
		ave.	1.87
Sorgo 46B	7.7	11.3	1.93
49B	9.5	13.1	1.46
53B	5.4	9.0	1.56
171C	7.4	11.0	1.42
175C	11.1	14.7	1.77
179C	10.0	13.6	1.89
227C	10.8	14.4	1.93
368C	6.1	9.7	1.67
371C	7.6	11.2	1.94
		ave.	1.73

Table 7d. Feed consumption--Period 4

	Silage D.M. consumption	Total D.M. consumption	D.M. consumption
Sudo	lb./day	lb./day	lb./cwt.
54B	7.3	10.9	1.58
173C	13.6	17.2	1.81
176C	10.1	13.7	1.63
178C	7.7	11.3	1.75
228C	11.8	15.4	1.93
229C	6.9	10.5	1.42
367C	5.1	8.7	1.30
370C	4.4	8.0	1.44
485C	8.1	11.7	1.61
		ave.	1.61
Sorgo			
46B	6.2	9.8	1.61
49B	8.4	12.0	1.33
53B	6.3	9.9	1.74
171C	6.8	10.4	1.32
175C	10.5	14.1	1.62
179C	9.0	12.6	1.67
227C	9.6	13.2	1.66
368C	5.8	9.4	1.55
371C	6.6	10.2	1.75
		ave.	1.58

Table 7e. Feed consumption--Period 5

	Silage D.M. consumption	Total D.M. consumption	D.M. consumption
Sudo	lb./day	lb./day	lb./cwt.
54B	7.1	10.7	1.54
173C	13.4	17.0	1.76
176C	10.2	13.8	1.63
178C	8.1	11.7	1.75
228C	10.4	13.7	1.72
229C	7.1	10.7	1.44
367C	5.1	8.7	1.24
370C	4.8	8.4	1.52
485C	7.2	10.8	1.47
		ave.	1.56
Sorgo			
46B	6.0	9.6	1.61
49B	8.7	12.3	1.33
53B	6.6	10.2	1.74
171C	6.9	10.5	1.35
175C	10.0	13.6	1.55
179C	9.0	12.6	1.66
227C	9.8	13.4	1.66
368C	4.5	8.1	1.37
371C	6.8	10.4	1.75
		ave.	1.56

A COMPARISON OF NUTRITIVE VALUE OF SUDO AND SORGO SILAGE

by

THOMAS E. SHULTZ

B. S., University of New Hampshire, 1954

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Dairy Husbandry

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1961

Sorghums and Sudan grass are forages adapted to areas of varied amounts of rainfall and can tolerate hot, dry periods where other crops fail to yield satisfactorily. When storage space is available, sorghums are harvested and stored as insurance against future dry periods. Sorghums can be made into excellent silage when harvested at the right stage of maturity and ensiled properly.

This study was conducted to compare the nutritive value of Atlas sorgo, a heavily seeded sorghum and "Sudo", a lightly seeded hydrid of Sudan grass and a forage sorghum, as the only roughage for growing dairy heifers. Obtaining the most economical growth and utilizing the available and best adapted and highest yielding forage of a specific area are two important aspects of the overall farm enterprise.

Sudo silage contained more crude protein more crude fiber and less nitrogen-free extract than did the sorgo silage. The lesser proportion of nitrogen-free extract probably was due to lower seed content. Sudo also contained slightly more dry matter. Because sorghum seeds pass through the digestive tract in large quantities unutilized, the efficiency of the heavily seeded sorghums has been questioned. It would seem that the heavier seeded Atlas sorgo would contain more crude protein than Sudo, however, this was not the case.

Eighteen yearling dairy heifers were used in a ten-week continuous trial to evaluate the two silages. The silages were fed in measured ad libitum quantities. The silage was

supplemented with ground corn and soybean oil meal to insure adequate protein intake and to increase dry matter intake.

Dry matter intake is the critical factor when silage is the only roughage in a ration for growing heifers. This study demonstrated the inability of heifers to consume enough silage in order to make satisfactory growth equal to Morrison's standard. The heifers on the Sudo ration consumed more silage, consequently had a higher total dry matter intake per day than did those on the Sorgo ration; 1.65 pounds per 100 pounds body weight and 1.61, respectively. Growth rate in gains per day were the same for both groups; 0.94 pound. Silage consumption for both groups was greatest during the colder third period.

The results of this study indicate that the lightly seeded Sudo is slightly less efficient in producing weight gains than Sorgo since the greater amounts of Sudo silage consumed per day resulted in the same rates of growth as were obtained with the sorgo silage. Further, dry matter consumption is less than optimum to obtain desired growth even when supplemented with a concentrate, when sorghum silage is the only roughage for growing dairy heifers.