8-1947

Studies of three millets and three Sudan grasses as supplemental summer pasture

Odie B. Stover Jr.

To the Graduate Council:

I am submitting herewith a thesis written by Odie B. Stover Jr. entitled "Studies of three millets and three Sudan grasses as supplemental summer pasture." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

Eric Winters, Major Professor

We have read this thesis and recommend its acceptance:

Lawrence N. Skold, J. R. Leasure

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

August 8, 1947

To the Committee on Graduate Study:

I am submitting to you a thesis written by Odie B. Stover, Jr., entitled "Supplemental Summer Pasture Studies on Three Millets and Three Sudan Grasses." I recommend that it be accepted for nine quarter hours credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

E. Winters

Major Professor

We have read this thesis
and recommend its acceptance:

L M Skold

J K Leasure

Accepted for the Committee

Dean of the Graduate School

STUDIES OF THREE MILLETS AND THREE SUDAN GRASSES AS SUPPLEMENTAL SUMMER PASTURE

A THESIS

Submitted to
The Committee on Graduate Study
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

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by

Odie B. Stover, Jr.

August 1947

ACKNOWLEDGMENT

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INTRODUCTION

Supplemental summer pastures are in great demand by many Tennessee farmers who raise dairy or beef cattle. Little data are available, however, to aid these farmers in selecting the best varieties of grasses or legumes to serve this purpose. Specifically, information is lacking on the two new varieties of Sudan grass, Sorghum vulgare var. sudanense, which only recently have been introduced. These new varieties need to be compared as to palatability and yields with other crops that are now serving the farmer as a supplemental summer pasture.

Until data are available on such problems, definite supplemental summer pasture practices cannot be recommended with assurance. This investigation was conducted to obtain information that could be applied toward the solution of the problems mentioned above.

Briefly, the plan of the experiment was to secure data on palatability and yields of six major varieties adapted for summer supplemental pastures in order to determine which ones might be well adapted to Tennessee conditions.

REVIEW OF LITERATURE

A search of the literature discloses that much data exist, but only a small amount has been published in recent years. Furthermore, the data available have been obtained mostly in other states and hence have limited application to Tennessee. In South Carolina, Cathcart (4) found that pearl millet, Pennisetum glaucum, produced 42.9 per cent more nutrients per acre when grazed than when harvested for silage. Pearl millet yielded 740.58 pounds of total digestible nutrients per acre and furnished grazing for 68.25 cow days per acre. The average yield per acre expressed in terms of alfalfa hay equivalent was 1,472 pounds when grazed and 1,030 pounds when ensiled. Vinall (16) reported pearl millet to be better for use as a green feed than the foxtail millets, Seteria italica, because of its larger yield and its ability to make a second growth after being cut down. Foxtail millet is not recommended for pasture because it has a shallow root system and does not renew growth very quickly after being eaten off. Sudan grass may replace millet in some localities because of its high yield and longer growing season. Oregon workers (15) report that foxtail millet is seldom grown for pasture; however, on soils having good fertility and moisture, it produces considerable pasture after a hay crop is harvested. Foxtail millet grows under more moist and cooler conditions than Sudan grass.

Texas workers (10) report that Sudan grass is a vigorous growing, dependable annual summer pasture and emergency hay crop. On productive soils and under favorable weather conditions, one acre of

Sudan grass will provide pasture for two or more cows during the time it is available. All or part of the field may be harvested for hay at the heading out stage, and the second growth pastured, after it has again reached a height of at least one foot. On productive lands, Sudan grass should be twelve to fifteen inches high five or six weeks after planting. Pasturing should be avoided prior to that time, since the young, short plants may contain sufficient cyanide to be poisonous. Rotational grazing should be practiced. Sudan grass may be pastured until killed by frost. Even after frosts, Sudan grass is may be safely pastured, since frosting does not increase the cyanide content. It is suggested that when animals are first turned into a Sudan grass pasture, they be observed for an hour. Healthy, vigorous, well-fed animals usually stop eating within a short time and look around for other grass to eat if there is sufficient poison present to be dangerous.

Schoth and Rampton (15) found under Oregon conditions that Sudan grass makes satisfactory pasture for cattle, horses, sheep, and hogs, and is sometimes used for turkey range. Clipping is recommended after uneven pasturing or excess trampling. Sudan grass that is short and dark sometimes develops dangerous amounts of hydrocyanic acid and when pastured, poisoning may result. Cole, Mead, and Regan (5) report that bloat rarely, if ever, occurs in normal animals on Sudan pastures. Dawson, Graves, and Van Horn (6) found that fifty per cent of Sudan grazing was obtained in July, and the remainder was fairly equally distributed between August, September, and October. Paul (13) reports twenty-five acres of Sudan has pastured twenty-five dairy cows

continuously from July until frost. Two plots were used for pasture, alternating every two weeks. Some cows have increased their daily production as much as ten or fifteen pounds per day with no decrease in test. Paul (13) also reports soybeans can well be put in with Sudan grass and that the practice is especially desirable in territories infested by chinch bugs, since the beans are resistant to this insect. In Indiana, Reed (14) reports that Sudan grass is the best emergency summer pasture crop for Indiana, especially for cattle and sheep and ranks next to rape as an emergency pasture for hogs.

In Michigan, Dorrance (7) reports that Sudan compared to other crops on sandy loam soil proved far more productive than rape, alfalfa, or sweet clover. Texas workers (10) report that the average cost of gain will be less in using Sudan grazing if the steers do not receive their concentrate feeds until they are placed in dry lots. Gorton (9) in Oregon reports the cost per animal-unit day of grazing Sudan was 7.8 cents for the average of 156 animal-unit days produced per acre. Wisconsin workers (1) report maximum production is obtained by delaying grazing until plants have reached a height of two or three feet and are relatively free of poison. Fergus (8) found that Sudan furnished a valuable supplemental pasture after summer heat reduced the productivity of other pastures. Texas workers (2) report Sudan grass may furnish grazing for 70 to 175 days, depending on the season.

McIntyre (12) reports that Texas observers claim livestock always show a decided preference for Sweet Sudan over the Common kind. United States Department of Agriculture workers at the Plant Industry Station, Beltville, Maryland, recognize that on separate free-choice

feeding systems, cattle may temporarily graze on Sweet Sudan first. Yet, if a solid plot is sown to Common, Sweet, and Tift Sudan, Department men say cattle will eat it all, without any preference for the new Sweet Sudan. As yet, no great difference in its net feeding value has been determined. Tift Sudan is more resistant to leaf and stem disease than Sweet and Sweet Sudan is more resistant than Common Sudan to leaf and stem disease.

In Georgia, Burton (3) reports Tift Sudan contains more prussic acid than Common Sudan. It is more resistant to disease than Sweet or Common Sudan. Tift Sudan may be grazed when it is eighteen to twenty-four inches high, but is palatable and readily eaten even in the early heading stage. The preliminary reports indicate that in most places, Tift Sudan should produce more grazing, especially late in the season, than Common Sudan.

EXPERIMENTAL PROCEDURE

The investigation was conducted on a Decatur soil located on the Tennessee Agricultural Experiment Station farm in Blount County, in 1946. At the end of the experiment, two soil samples were taken from the unfertilized soil along the edge of the plots to determine the approximate fertility.

The grasses used were Sweet Sudan, Common Sudan, Tift Sudan, Tennessee German millet, Setaria italica, browntop millet, Panicum fasciculatum, and pearl millet. Before seeding, a 5-10-5 fertilizer was applied to the experimental area at the rate of 400 pounds per acre.

The crops were sown with a grain drill on May 28, 1946, at the rate of 31 pounds per acre. A satisfactory stand of all crops was obtained. The plots, 11 feet wide x 99 feet long, or one-fortieth acre, were arranged in a randomized block design. A twelve-foot roadway of Sweet Sudan grass was placed in the middle with twelve plots on each side of the roadway. A six-foot border of Sweet Sudan grass was placed on the east and west sides of the plots with a fifteen-foot lespedeza strip between these borders and the fence. A twelve-foot roadway of lespedeza was left between the ends of the plots, on the north and south sides, and the fence.

Wire pasture cages four feet square were placed on the plots before grazing started. Plant height was measured in five different areas on each plot and the values averaged for each plot. The measuring stick was placed on the ground and the grass straightened up with the hand.

Steers were turned into the area and timed to the half-minute as to what they were grazing. Four or six steers were usually grazing at the same time. After the steers had eaten the grasses fairly close, they were removed and the grass under the cages clipped with hand shears to within one inch of ground and weighed to secure the total yield. The pasture cages were then moved to an average grazed area on the same plot and the ungrazed grass remaining in this four-foot-square area was clipped to within one inch of the ground and weighed to determine the refusal. The grass was oven dried to secure the dried weights.

The first grazing began July 8, 1946. Two other grazings were made and yields obtained, one the middle of August and the other the last of September. The lack of rainfall was the determining factor in the number of grazings obtained.

During each grazing period after the three or four palatability trials, a large group of steers were turned into the experimental area.

When one of the plots became grazed to the point where it was injurious to the grasses to be grazed lower, usually two inches off the ground, all steers were taken off the area. After each grazing, the plots were clipped with a horse-drawn mowing machine.

EXPERIMENTAL RESULTS

Data on height of Sweet Sudan, Tift Sudan, Common Sudan, Tennessee German millet, browntop millet, and pearl millet are presented in Table II. Data on palatability of the above-mentioned grasses are presented in Table III and data comparing yields per acre are presented in Table IV. The values reported in these tables are averages of four replications. Soil fertility of the experimental area is shown in Table I. The individual plot data on height at time grazing began, palatability, and yields per acre of each plot are given in Appendices B, C, D, E, F, G, and H.

The results and their interpretations are discussed under the following headings: (1) Soil Fertility, (2) Height, (3) Palatability, and (4) Yield.

Soil Fertility

Soil fertility tests are shown in Table I. Soil samples were taken along the east and west sides, which were the sloping sides of the experimental area. Both samples were acid and low in available phosphate. The east side represented the part that was the most eroded with the subsoil exposed at the surface in a small portion of the area. The west side was higher in available potash and organic matter (darker color), probably due in part to the presence formerly of an old hay stack on the southwest corner.

TABLE I

THE pH, AVAILABLE POTASH, AND AVAILABLE PHOSPHORUS OF THE SOIL IN THE EXPERIMENTAL AREA

Location of Sample	pH	Available Phosphate	Available Potash
East	5.4	Very low (1)	Very low(80)
West	5.5	Very low (1)	Very high

Soil samples were sent to the State Soil Testing Laboratory at Nashville and were analyzed there.

TABLE II

HEIGHT MEASUREMENT OF GRASSES

Variety	Height Measurement in Feet			
	First Grazing	Second Grazing	Third Grazing	Average Height
Sweet Sudan	4.2[a]	2.3	2.0	2.8
Common Sudan	5.2	2.6	2.5	3.4
Tift Sudan	4.3	2.5	2.3	3.0
Tennessee German Millet	3.2	1.6	0.0	1.6
Browntop Millet	2.6	1.4	0.8	1.3
Pearl Millet	3.9	2.5	1.7	2.7

[a] Each value is the average of 5 measurements from each of the 4 replications.

Height

The comparative height of each variety is shown in Table II and Appendices B, C, and D. The Sudans grew higher than the millets. The order of height growth was Common Sudan, Tift Sudan, Sweet Sudan, pearl millet, Tennessee German millet, and browntop millet.

Palatability

The location of each plot inside the experimental area is shown in Figure 1. The calculation for the amount of time the steers spent on Sweet Sudan grass was based on the amount of grazing on the four plots of Sweet Sudan, the two six-foot Sweet Sudan borders, and the twelve-foot Sweet Sudan roadway in the center of the experimental area.

The time spent grazing each variety is shown in Table III. The order of palatability was Sweet Sudan, Tift Sudan, Common Sudan, browntop millet, pearl millet, and Tennessee German millet. This is based on the entire grazing season. The palatability of each variety varied some with each of the three grazing periods as shown in Appendix E. Browntop millet was second choice in the first grazing period, pearl millet increased from sixth place in palatability during the first grazing period to fourth place in the second grazing period, and remained fairly high in the third period. The three Sudan grasses ranked higher than the millets in both the second and third periods.

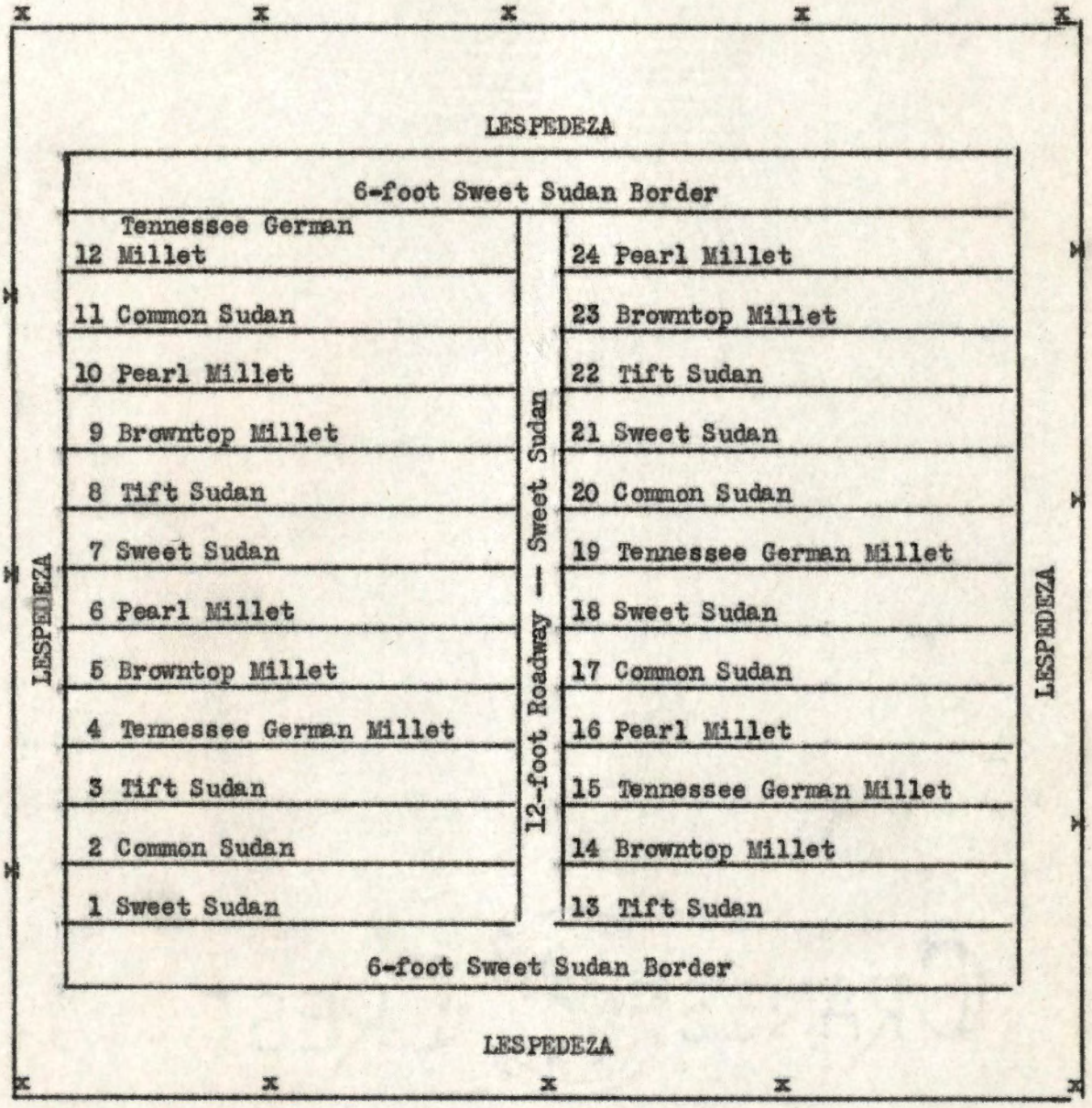
TABLE III

TIME INTERVALS STEERS SPENT IN GRAZING
ON MILLETS AND SUDAN GRASSES

Variety	Number of Minutes Steers Grazed for the Three Grazing Periods
Sweet Sudan	1548.5[a]
Tift Sudan	685.5
Common Sudan	674.0
Browntop Millet	532.5
Tennessee German Millet	60.0[b]
Pearl Millet	445.5
Lespedeza	750.0
Inactive	1030.0
Total	5726.0

[a] Includes 740 minutes on Sweet Sudan roadway and border; 808.5 minutes were on Sweet Sudan plots.

[b] Two periods only.



DESIGN OF SUPPLEMENTAL SUMMER PASTURE EXPERIMENT

Figure 1

Tift Sudan looked more attractive due to its greenness and freedom from disease. Common Sudan and Sweet Sudan developed large areas of leaf blight and anthracrose, which caused many of their blades to curl up, dry out, and finally die. Browntop millet had a woody appearance, due to drought in the summer. (See Figures 2 and 3). After the first grazing period it was less palatable.

Tennessee German millet grew very rapidly after seeding and was almost mature when the first grazing period started. This made it less palatable and since it died after the second grazing period, it furnished no forage during the third grazing period.

Yields

The comparative yields of each variety are shown in Table IV. Pearl millet produced the greatest amount of green forage, also, the greatest amount of forage, oven-dried basis. The steers grazed more on both green and on oven-dried basis from Tift Sudan than from any other variety.

The greatest green refusal; that is, forage produced but not consumed, was produced by Pearl millet; the least by Tift Sudan. The greatest dry refusal was produced by Tennessee German millet, the least by Tift Sudan. Yields of each plot are shown in Appendices F, G, and H.

TABLE IV

A COMPARISON OF DIFFERENT VARIETIES
AS TO YIELDS PER ACRE

	Green Feed Produced Per Acre			Dry Feed Produced Per Acre		
Variety	Total	Refusal	Net	Total	Refusal	Net
Sweet Sudan	22,914	7,064	15,850	3,759	878	2,881
Common Sudan	22,683	8,913	13,770	4,362	1,837	2,525
Tift Sudan	24,854	5,190	19,664	4,703	912	3,791
Tennessee German Millet	17,339	11,623	5,716	4,885	4,328	557
Browntop Millet	20,647	7,493	13,154	5,233	2,212	3,021
Pearl Millet	35,848	16,305	19,543	6,736	3,917	2,819

(1) (2) (3)

Height and appearance of (1) Common Sudan, on left, of (2) Tennessee German Millet, in the center, and (3) Sweet Sudan on the right, two days before the third grazing period began.

Figure 2

(1)

(2) (3)

Height and appearance of (1) Pearl Millet, extreme upper left, of (2) Browntop Millet, left center, and of (3) Tift Sudan, on the right, two days before time for the third grazing period to begin.

Figure 3

DISCUSSION

Recommendations and conclusions based upon the results of this experiment must necessarily be considered tentative for several reasons. First, they are based upon only one year's results and the forage yields were somewhat influenced by unfavorable weather conditions. The weather in the latter part of July and during August was extremely cool for that season of the year. The months of June and July had very little rainfall. These weather data are presented in Appendix A. There were only 36.56 inches of rainfall for the entire year of 1946. Second, the data were obtained under conditions where six different varieties were grazed as one grazing grass and not as separate grazing grasses. Some of the varieties should have been grazed more often than could be done under the program carried out. Third, each plot should have had its own fertility test with two or three tests being made on each plot. There was great soil variability, some areas having subsoil exposed, whereas part of the plots had deep top soil. The southeast portion of the experimental area had at one time a hay stack on it. This hay stack had decomposed there and probably cattle eating there had left droppings that increased the fertility of the soil.

The border area should have been in something besides one of the varieties being tested, because that gave the steers a larger area of one variety from which to choose.

From the standpoint of total forage production, pearl millet ranked first. Tift Sudan will furnish more grazing in July and August,

probably when supplemental summer pasture is in greatest demand. Tift Sudan furnished both more net green and dry feed than any of the other varieties tested.

One of the main reasons for Tift Sudan producing the greatest amount of net feed is its resistance to diseases. There was little difference in the palatability of the three Sudan grasses during the second and third grazing periods.

Common Sudan grew the tallest, with all Sudan grasses growing taller than the millets. Pearl millet grew the tallest of the millets while browntop millet grew the least in height.

Yields per acre of each of the six varieties would undoubtedly have been higher if the plot acreage had been large enough to permit grazing at the optimum time for each grass. The millets were handicapped by not being grazed more often. It was impossible to do so since the time and number of grazings were based upon the height and cyanide content of the Sudan grass. Therefore, the experiment does not furnish an acceptable variety comparison.

The fertility of the soil as shown in the east soil sample was strongly acid and very low in available phosphate and potash. The west soil sample had about the same acidity, was very low in available phosphate and very high in available potash. The high potash content in the west soil sample is probably due to part of the soil sample being taken where an old hay stack once stood.

The present results agree with those of Vinall (10), in showing that pearl millet is better for use as a green feed than the foxtail millets, because of its larger yield and its ability to make a second

growth after being cut down. The present work shows that livestock have a slight preference for Sweet Sudan over Common Sudan at certain times. This is essentially in agreement with United States Department of Agriculture workers at the Plant Industry Station, Beltville, Maryland.

In Georgia, Burton (3) reports that Tift Sudan contains more prussic acid than Common Sudan. It is more resistant to disease than Sweet or Common Sudan and should produce more grazing, especially late in the season, than Common Sudan. The present work substantiates these findings relative to productivity and disease resistance.

SUMMARY

Yield and palatability tests were conducted with six varieties of grasses that may have a place as supplemental summer pasture plants. Four replications of each of the six varieties were seeded.

Tift Sudan furnished the greatest yield in pounds as harvested by steers. Pearl millet produced the greatest yield in green forage, however, much of this was not eaten by steers. The top of pearl millet was found to be very palatable while the stalk was very coarse and unpalatable. Tennessee German millet produced the least feed of any of the varieties studied.

Palatability tests of the second and third grazing periods and the total yield in pounds, oven-dried basis, as harvested by steers, indicate that of the six varieties tested in this experiment, Tift Sudan is the best supplemental summer pasture grass. Sweet Sudan ranked second, Common Sudan third, pearl millet fourth, browntop millet fifth, and Tennessee German millet sixth.

There was no indication of cyanide poisoning or bloating of the steers during the entire experiment.

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APPENDICES

APPENDIX A

MONTHLY WEATHER DATA FROM THE UNIVERSITY OF TENNESSEE EXPERIMENTAL STATION FARM IN BLOUNT COUNTY, 1946

Month	Minimum Temperature	Maximum Temperature	Average Temperature	Rainfall
January	-	-	-	6.55
February	-	-	-	4.30
March	-	-	-	2.68
April	30.	82.	60.47	3.10
May	40.	85.	67.13	5.86
June	50.	91.	73.71	.60
July	64.	92.	78.13	1.70
August	54.	90.	74.19	.90
September	47.	90.	68.13	1.30
November	-	-	-	3.31
December	-	-	-	4.16
		TOTAL		36.56

Readings were taken at 6:00 A.M. daily.

APPENDIX B

HEIGHT MEASUREMENT OF PLANTS AT THE FIRST GRAZING PERIOD

Variety	Replication Number	Height Measurement in Feet					Average Height in Feet	Average of Four Replications
		First	Second	Third	Fourth	Fifth		
Sweet Sudan	I	3.8	4.5	4.5	4.0	4.1	4.2	
	II	4.0	3.6	4.2	3.9	4.6	4.2	
	III	3.6	3.5	4.5	4.4	4.5	4.1	
	IV	4.5	4.7	4.0	4.5	4.3	4.4	
								4.2
Common Sudan	I	5.1	5.0	4.6	5.8	4.8	5.1	
	II	5.1	6.0	5.1	5.4	5.6	5.4	
	III	5.2	5.5	4.8	4.8	4.7	5.0	
	IV	5.3	4.6	5.0	5.0	5.3	5.1	
								5.2
Tift Sudan	I	4.0	3.3	3.5	4.3	3.9	3.8	
	II	4.0	4.8	3.9	4.1	4.3	4.2	
	III	4.2	4.4	4.3	4.0	4.6	4.3	
	IV	3.7	5.2	5.1	5.0	5.1	4.8	
								4.3
Tennessee German Millet	I	3.2	3.5	3.3	3.1	2.8	3.2	
	II	3.5	3.9	3.0	3.6	3.1	3.7	
	III	3.6	3.3	3.0	3.0	2.6	3.1	
	IV	3.8	2.5	2.6	2.9	2.6	2.9	
								3.2
Browntop Millet	I	2.5	2.5	2.7	2.6	2.2	2.5	
	II	2.1	3.0	2.8	2.6	2.5	2.6	
	III	2.6	2.4	2.4	2.7	2.7	2.6	
	IV	3.0	2.7	2.8	2.8	2.6	2.8	
								2.6
Pearl Millet	I	4.4	4.2	2.9	3.2	3.4	3.6	
	II	4.3	4.3	5.1	5.2	4.3	4.6	
	III	3.0	2.8	2.4	3.0	4.7	3.2	
	IV	3.8	5.7	4.1	3.4	4.2	4.2	
								3.9

APPENDIX C

HEIGHT MEASUREMENT OF PLANTS AT THE SECOND GRAZING PERIOD

Variety	Replication Number	Height Measurement in Feet					Average Height in Feet	Average of Four Replications
		First	Second	Third	Fourth	Fifth		
Sweet Sudan	I	1.8	2.3	2.5	2.3	3.3	2.4	
	II	1.5	1.5	2.2	3.0	3.4	2.3	
	III	1.6	2.6	2.3	3.0	3.0	2.5	
	IV	2.2	2.6	1.8	2.4	2.0	2.2	
								2.3
Common Sudan	I	3.6	2.8	2.6	2.1	1.8	2.2	
	II	2.6	2.6	3.1	3.2	2.4	2.8	
	III	2.3	2.2	1.7	2.7	2.1	2.2	
	IV	3.5	2.7	3.6	3.2	2.9	3.2	
								2.6
Tift Sudan	I	1.3	1.9	1.7	1.4	2.6	1.8	
	II	3.4	3.1	2.9	2.1	1.5	2.6	
	III	3.1	3.0	1.8	1.7	1.8	2.3	
	IV	3.4	3.7	3.6	3.1	2.6	3.3	
								2.5
Tennessee German Millet	I	1.0	1.7	1.7	1.8	1.2	1.6	
	II	1.8	1.4	1.2	1.3	1.7	1.5	
	III	1.8	1.4	1.5	1.6	1.3	1.5	
	IV	2.2	1.6	1.8	1.7	1.5	1.8	
								1.6
Browntop Millet	I	1.7	1.5	1.6	1.8	1.2	1.6	
	II	1.0	1.1	1.0	1.2	1.8	1.3	
	III	1.3	1.0	.9	1.6	1.3	1.2	
	IV	1.6	1.5	1.4	1.3	1.6	1.5	
								1.4
Pearl Millet	I	1.8	1.4	3.0	2.3	2.4	2.4	
	II	3.5	2.7	2.7	2.4	1.7	2.6	
	III	2.7	2.0	1.7	1.7	1.7	2.0	
	IV	2.3	3.3	2.1	3.8	2.6	2.8	
								2.5

APPENDIX D

HEIGHT MEASUREMENT OF PLANTS AT THE THIRD GRAZING PERIOD

Variety	Replication Number	Height Measurement in Feet					Average Height in Feet	Average of Four Replications
		First	Second	Third	Fourth	Fifth		
Sweet Sudan	I	1.9	2.4	2.0	1.2	2.0	1.9	
	II	2.0	1.7	1.5	2.5	3.1	2.2	
	III	2.6	1.9	2.8	1.6	3.0	2.2	
	IV	1.0	2.2	1.8	1.5	2.4	1.8	
								2.0
Common Sudan	I	2.5	1.6	1.5	2.8	2.0	2.1	
	II	2.8	2.6	1.7	3.8	1.5	2.5	
	III	2.7	2.4	2.5	1.6	3.9	2.6	
	IV	2.4	1.9	2.8	2.0	4.0	2.6	
								2.5
Tift Sudan	I	2.6	1.6	1.4	2.2	2.1	2.0	
	II	2.7	1.5	2.0	1.8	2.0	2.0	
	III	3.1	2.5	2.6	2.7	2.9	2.8	
	IV	3.2	1.7	2.4	1.0	3.3	2.5	
								2.3
Tennessee German Millet	I	0	0	0	0	0	0	
	II	0	0	0	0	0	0	
	III	0	0	0	0	0	0	
	IV	0	0	0	0	0	0	
								0
Browntop Millet	I	0.7	1.3	0.4	1.0	0.6	0.8	
	II	0.9	0.6	1.0	0.8	1.1	0.9	
	III	0.8	0.7	0.7	0.8	1.0	0.8	
	IV	1.0	1.1	0.6	0.8	0.5	0.8	
								0.8
Pearl Millet	I	1.0	2.0	0.8	2.8	1.5	1.6	
	II	1.6	1.9	1.2	2.9	1.8	1.9	
	III	1.8	1.0	0.8	2.6	2.0	1.6	
	IV	0.9	0.7	1.4	1.8	3.6	1.7	
								1.7

APPENDIX E

TIME INTERVALS STEERS SPENT IN GRAZING
THE MILLETS AND SUDAN GRASSES

Grazing Date	Number of Minutes Steers Grazed on								Total Number of Minutes
	Sweet Sudan	Tift Sudan	Common Sudan	Browntop Millet	Tennessee German Millet	Pearl Millet	Lespedeza	Inactive	
July 8 (PM)	132.0	21.0	28.0	82.5	5.0	4.0	257.0	58.5	588.0
July 9 (AM)	172.5	7.0	28.5	77.0	3.0	2.0	184.0	29.0	503.0
July 10 (AM)	305.5	31.0	59.0	64.5	15.0	6.0	52.0	318.0	851.0
TOTAL	610.0 *	59.0	115.5	224.0	23.0	12.0	493.0	405.5	1942.0
Aug. 16 (AM)	119.5	109.0	90.5	46.0	14.5	91.0	43.0	46.5	560.0
Aug. 16 (PM)	134.5	119.0	67.0	39.5	2.5	91.5	7.0	61.0	522.0
Aug. 17 (AM)	155.0	107.0	101.0	20.0	13.0	114.5	62.0	3.5	576.0
Aug. 17 (PM)	252.0	30.5	86.0	62.5	7.0	19.0	1.0	364.0	822.0
TOTAL	661.0 **	365.5	344.5	168.0	37.0	316.0	113.0	475.0	2480.0
Sept. 23(PM)	46.5	66.5	56.5	8.0	.0	19.0	26.0	5.5	228.0
Sept. 24(AM)	157.0	133.0	124.0	118.0	.0	64.0	76.5	59.5	732.0
Sept. 25(AM)	74.0	61.5	33.5	14.5	.0	34.5	41.5	84.5	344.0
TOTAL	277.5 ***	261.0	214.0	140.5	.0	117.5	144.0	149.5	1304.0
GRAND TOTAL	1548.5 ****	685.5	674.0	532.5	60.0	445.5	750.0	1030.0	5726.0

* 332.5 minutes spent on Sweet Sudan border and runways and 277.5 minutes spent on Sweet Sudan plots.
** 309 minutes spent on Sweet Sudan border and runways and 352 minutes spent on Sweet Sudan plots.
*** 96.5 minutes spent on Sweet Sudan border and runways and 179 minutes spent on Sweet Sudan plots.
**** 740 minutes spent on Sweet Sudan border and 808.5 minutes spent on Sweet Sudan plots.

APPENDIX F

YIELDS PER ACRE OF EACH PLOT AT FIRST GRAZING PERIOD

Variety	Replication	Green			Dry		
		Plot Weight	Refusal Weight	Net Weight	Plot Weight	Refusal Weight	Net Weight
Sweet Sudan	I	16550	3865	12690	2531	653	1878
	II	14644	4083	10561	2368	626	1742
	III	14862	9799	5063	2069	1034	1035
	IV	17375	8983	8392	1832	953	879
Average		15858	6683	9175	2200	817	1383
Common Sudan	I	15325	4900	10425	2531	925	1406
	II	15597	8602	6995	2504	1878	626
	III	13419	7839	4380	2286	1688	598
	IV	15951	11813	4138	2749	2259	490
Average		15073	8289	7784	2518	1688	830
Tift Sudan	I	16223	2286	13937	2205	327	1878
	II	16834	6315	10519	2286	925	1361
	III	13583	4301	9282	2178	735	1443
	IV	19381	7295	12086	2831	1479	1334
Average		16505	5049	11456	2375	871	1504
Tennessee German Millet	I	16659	8602	8057	3185	2668	517
	II	15679	9854	5825	3756	3430	326
	III	10425	7186	3239	2654	2531	123
	IV	12493	9473	3020	3436	3831	599
Average		13814	8779	5035	3258	2865	393
Browntop Millet	I	13882	6859	7023	2885	1769	1116
	II	12493	5880	6613	2613	1688	925
	III	13583	5880	7703	3158	1552	1606
	IV	14046	6152	7894	2749	1497	1252
Average		13501	6193	7408	2851	1627	1224
Pearl Millet	I	23273	11324	11949	3103	2042	1061
	II	30269	12576	17693	4246	2940	1306
	III	13256	10398	2858	2368	2150	218
	IV	22130	12086	10044	3511	2470	1041
Average		22234	11596	10638	3307	2401	906

APPENDIX G

YIELDS PER ACRE OF EACH PLOT AT SECOND GRAZING PERIOD

Variety	Replication	Green			Dry		
		Plot Weight	Refusal Weight	Net Weight	Plot Weight	Refusal Weight	Net Weight
Sweet Sudan	I	3620	0	3620	708	0	708
	II	2067	0	2067	708	0	708
	III	5771	572	5199	953	109	844
	IV	5927	953	3974	1116	136	980
Average		4096	381	3715	871	61	810
Common Sudan	I	2613	0	2613	683	0	683
	II	2776	0	2776	708	0	708
	III	4600	1192	3408	1089	272	817
	IV	6043	1307	4736	1443	327	1116
Average		4008	625	3383	981	150	831
Tift Sudan	I	2286	0	2286	1062	0	1062
	II	1851	0	1851	490	0	490
	III	3484	599	2885	1824	163	1661
	IV	4981	0	4981	898	0	898
Average		3151	150	3001	1069	41	1028
Tennessee German Millet	I	1606	1062	544	735	544	191
	II	6261	7077	-816	3266	3511	-245
	III	4029	1905	2124	1707	1225	572
	IV	2205	1334	871	708	571	137
Average		3525	2844	681	1627	1463	164
Browntop Millet	I	5716	2259	3457	1769	1225	544
	II	3430	1062	2368	953	327	626
	III	3511	1307	2204	1116	599	517
	IV	5145	572	4573	1143	191	1252
Average		4451	1300	3151	1320	585	735
Pearl Millet	I	8656	5825	2831	2232	1688	544
	II	5743	5736	1007	2395	2170	225
	III	5798	1034	4764	1143	163	980
	IV	9772	7241	2531	2531	2042	489
Average		7492	4709	2783	2075	1516	559

APPENDIX H

YIELDS PER ACRE OF EACH PLOT AT THIRD GRAZING PERIOD

Variety	Replication	Green			Dry		
		Plot Weight	Refusal Weight	Net Weight	Plot Weight	Refusal Weight	Net Weight
Sweet Sudan	I	2341	0	2341	681	0	681
	II	3130	0	3130	735	0	735
	III	3675	0	3675	735	0	735
	IV	2695	0	2695	599	0	599
Average		2960	0	2960	688	0	688
Common Sudan	I	3021	0	3021	817	0	817
	II	2531	0	2531	626	0	626
	III	4192	0	4192	925	0	925
	IV	4736	0	4736	1089	0	1089
Average		3620	0	3620	864	0	864
Tift Sudan	I	5090	0	5090	1279	0	1279
	II	4029	0	4029	925	0	925
	III	6179	0	6179	1443	0	1443
	IV	5934	0	5934	1388	0	1388
Average		5308	0	5308	1259	0	1259
Tennessee German Millet	I	0	0	0	0	0	0
	II	0	0	0	0	0	0
	III	0	0	0	0	0	0
	IV	0	0	0	0	0	0
Average		0	0	0	0	0	0
Browntop Millet	I	3348	0	3348	953	0	953
	II	2450	0	2450	1089	0	1089
	III	1797	0	1797	898	0	898
	IV	3185	0	3185	1307	0	1307
Average		2695	0	2695	1062	0	1062
Pearl Millet	I	4110	0	4110	1007	0	1007
	II	7975	0	7975	1769	0	1769
	III	4950	0	4950	1007	0	1007
	IV	7458	0	7458	1633	0	1633
Average		6123	0	6123	1354	0	1354