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Effect of Management on Yield and Quality of Sudax Sorghum-Sudan Hybrid and Gahi-1 Pearlmillet*

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PEARLMILLET, sudangrass, and browntop millet have been grown in Alabama for many years as temporary summer pastures, particularly for dairy cattle. In recent years, however, sorghum-sudan hybrids have replaced much of the millet and sudan grown for dairy animals, and these crops are now widely planted for beef cattle grazing. More than 200,000 acres of the hybrid annuals were planted on Alabama farms in 1966.

Management and utilization of sorghum-sudan hybrids presents problems on many farms. Capacity of the crop to grow rapidly and produce large amounts of forage in a short time often results in wasted forage. Forage quality may be affected by various management practices, thus influencing animal performance on these annual grasses.

This leaflet summarizes results of management experiments with "Sudax" SX-11 sorghum-sudan hybrid and Gahi-1 pearlmillet at the Plant Breeding Unit, Tallassee.

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INDIVIDUAL TEST DETAILS

No. 1. Effect of Seeding Rate on Forage Quality and Yield of Sudax

Sudax was seeded May 20 in 6-inch rows with a belt seeder. Seeding rates were 10, 20, 30, 40, and 50 pounds per acre. A total of 220 pounds per acre of nitrogen was applied, split into three applications. Three harvests were made by cutting at a 6-inch stubble height when forage was in the early boot stage. Stem size was measured 10 inches above ground. The forage was analyzed for nitrogen, lignin, and fiber.

Using 30 pounds of seed per acre gave higher forage yields than the 10- or 20-pound rates and about the same as 40- and 50-pound seedings. The higher production at the 30-pound rate resulted from more forage at the first harvest, May 26. Yields at subsequent harvests were about the same from all seeding rates. Severe damage by zonate leafspot (*Gloecercospora sorghi*) probably was a factor in poor recovery and erratic stands during July. The poor recovery growth after August 3 did not warrant harvesting.

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TABLE 1. EFFECT OF SEEDING RATE ON FORAGE YIELD, LEAFINESS, AND STEM SIZE OF SUDAX, 1964

Seeding rate per acre, lb.	Dry forage per acre		Leaves in dry forage		Stem diameter	
	May 26	Season total	May 26	June 24	May 26	June 24
	Lb.	*Lb.*	*Pct.*	*Pct.*	*In.*	*In.*
50	2,240 a*	6,348 abc	68 a	80 a	7/32 b	9/32 b
40	2,128 a	7,191 a	60 a	66 b	6/32 b	9/32 b
30	2,100 a	6,734 ab	67 a	58 b	7/32 b	10/32 b
20	1,378 b	5,506 c	70 a	63 b	8/32 b	10/32 b
10	1,068 b	5,995 bc	63 a	58 b	12/32 a	13/32 a

* Least significant range for each column. Any two means not marked with the same letter are significantly different at .05 level.

TABLE 2. EFFECT OF SEEDING RATE ON CRUDE PROTEIN, LIGNIN, AND FIBER CONTENT OF DRY SUDAX FORAGE, 1964

Seeding rate per acre, lb.	Crude protein		Lignin		Fiber	
	May 26	June 24	May 26	June 24	May 26	June 24
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
50	13.5 a*	17.8 a	2.7 a	3.1 a	27.5 b	30.2 a
40	17.3 a	19.7 a	2.9 a	3.2 a	27.9 ab	31.7 a
30	15.6 a	18.6 a	3.0 a	3.5 a	29.1 a	32.5 a
20	15.8 a	16.3 a	3.0 a	3.4 a	29.2 a	30.9 a
10	15.6 a	19.5 a	2.9 a	3.1 a	29.1 a	32.1 a

* Least significant range. Any two means not marked with the same letter are significantly different at .05 level.

Seeding rate did not affect leafiness at the first harvest, Table 1. At the second cutting, however, leaf percentage was higher on areas seeded with 50 pounds per acre. No separations were made at the third harvest.

Stem diameter was unaffected by seeding rate except plants from the 10-pound rate had larger stems, Table 1. However, this difference was less at the second harvest. Thus, increasing the seeding rate above 30 pounds per acre to get maximum forage yield would not likely decrease stem size for faster hay curing.

Crude protein content of forage was uniformly high at both cutting dates and was not affected by seeding rate, Table 2. Lignin content was low and similar at all seeding rates, and this was not affected by stem size. Fiber content was generally unaffected by seeding rate, except for a slight reduction at the 50-pound seeding.

As shown by these results, seeding rate had little or no effect on forage quality under the nitrogen fertilization and clipping management used. From the practical standpoint, a seeding rate of 30 pounds per acre in 6-inch rows would be best.

No. 2. Effect of Stage of Maturity and Nitrogen Rate on Sudax Yield and Quality

To compare the 100- and 200-pound-per-acre rates of nitrogen, Sudax was planted in 6-inch rows using 30 pounds of seed per acre. Cutting was done at preboot, boot, bloom, and seed dough stages, beginning May 26 and ending September 16. Nitrogen was applied monthly at rates of 20 and 40 pounds per acre, and forage was harvested from May 26 to September 16. Prussic acid (HCN) content of forage was determined at each harvest. Other procedures were similar to those of Experiment 1.

At both levels of nitrogen, forage yields were generally higher when harvesting was delayed to the more mature

TABLE 3. EFFECT OF NITROGEN FERTILIZATION AND STAGE OF MATURITY ON YIELD AND QUALITY OF SUDAX, 1964

Nitrogen per acre and harvest stage	Total dry forage per acre	Season average leaves in dry forage	Total leaves per acre	Dry forage content, season average		
				Crude protein	Lignin	Fiber
	Lb.	*Pct.*	*Lb.*	*Pct.*	*Pct.*	*Pct.*
100 pounds N						
Pre-boot	4,524 c*	66 a	3,005 ab	9.3 a	3.6 c	33.8 c
Boot	5,075 c	47 b	2,382 c	7.1 b	4.8 b	35.6 b
Bloom	9,205 b	33 c	2,896 b	6.1 c	5.5 ab	37.9 a
Dough	11,117 a	29 c	3,252 a	4.8 d	6.1 a	39.3 a
200 pounds N						
Pre-boot	6,024 c	60 a	3,583 b	11.1 a	3.3 c	33.2 c
Boot	6,624 c	49 b	3,289 c	9.2 b	4.1 b	36.1 b
Bloom	10,827 b	30 c	3,178 c	6.5 c	5.4 ab	37.5 b
Dough	15,773 a	30 c	4,595 a	5.4 d	6.6 a	39.7 a

* Least significant range for each nitrogen level. Any two means not marked with the same letter are significantly different at .05 level.

stages, Table 3. Pre-boot and boot harvesting stages gave similar yields. When yields at all cutting stages were averaged, the 200-pound-per-acre nitrogen rate outyielded the 100-pound rate by more than a ton. Response to nitrogen was greatest when forage was cut in the dough stage.

Late summer recovery growth was poor on most plots, probably because of unusually high incidence of zonate leafspot. Unusually cloudy and wet weather in June, July, and August probably contributed to development of the disease.

Leafiness is generally considered to be an indicator of forage quality, and in this study leaf percentage declined sharply with advancing maturity. Nitrogen level had little effect on leafiness. When leaf production was calculated for each treatment at each harvest, it was found that total leaf production per acre was as high for more mature plants as for plants cut in the pre-boot and boot stages. This suggests that leafy forage would be available to grazing animals in about the same quantity regardless of growth stage when grazing was begun.

No differences in stem diameter was observed between treatments. The range in stem diameters was 7/32 to 10/32 inch for all treatments, with only a slight increase as the season progressed.

Crude protein content of forage, ranging from 4.8 to 11.1 per cent, was unusually low from all treatments. Differences in protein content between the 100- and 200-pound nitrogen rates favored the higher one by 1 to 2 per cent. Crude protein content dropped sharply as plants matured.

Content of lignin, an undesirable constituent, was relatively low in forage harvested at the pre-boot stage, but increased rapidly with maturity. Plants harvested at the dough stage contained nearly twice the lignin of plants cut at pre-boot. When cut at the dough stage, lignin contents were high enough to seriously lower animal digestibility. Fiber content increased slightly with maturity, but showed no effect from nitrogen rate.

Forage from all treatments tested low in prussic acid (HCN) throughout the season.

No. 3. Effect of Maturity on Digestibility of Sudax

For the digestibility trials, Sudax was planted at a rate of 30 pounds of seed per acre in 6-inch rows and fertilized with a total of 200 pounds of nitrogen in split applications. Forage was cut at the appropriate maturity (pre-boot, boot, and seed dough), dried one day in the field, and then dried in a forced air oven at 120°. The dry forage was then

chopped in a hammermill to pass through a ½-inch screen.

Weaned lambs less than 1 year old were used as experimental animals in digestion crates. Lambs were fed during a 10-day standardization and 7-day collection period. Fecal samples were collected and dry matter digestibility determined.

Stage of maturity had a pronounced effect on protein content of forage, Table 4. Sudax cut in the pre-boot stage was almost equal to the alfalfa hay used for a comparison, but protein content dropped sharply with maturity.

TABLE 4. CHEMICAL COMPOSITION, CONSUMPTION, AND DIGESTIBILITY BY LAMBS OF SUDAX AT THREE MATURITY STAGES AND ALFALFA, 1964

Forage and harvest stage	Crude protein	Daily intake as pct. of body weight	Dry matter digestibility
	Pct.	*Pct.*	*Pct.*
Sudax			
Pre-boot	15.5	2.9*	80.3*
Boot	8.2	2.7	70.0
Dough	7.4	2.7	64.2
Alfalfa	16.4	2.8	63.9

* Each figure is an average of results from 3 lambs.

Dry matter digestibility of Sudax forage was high at all maturity stages, going from above 80 per cent for early cut to slightly lower for more mature forage. Even Sudax cut at seed dough stage was similar to alfalfa hay in dry matter digestibility. It may be argued that results of this test are not indicative of forage quality since it was chopped in a hammermill. However, forage fed as unchopped would most likely have yielded even higher digestibility values because of animals rejecting stems. In this digestibility trial the lambs consumed both stems and leaves, making the results even more impressive. Daily intake of Sudax forage was comparable to intake of alfalfa hay, but all intake values were low. Lambs fed alone, as these were, seldom consume more than maintenance requirements. Low daily feed intake contributes to high digestion coefficients.

Comparing Sudax results with similar data for Coastal bermudagrass helps place the information in proper perspective. In many Auburn trials during the past few years with lambs and steers, dry matter digestibility of Coastal has ranged from 45 per cent for the poorest hay to not more than 55 per cent for the best quality. Sudax forage in the trial reported gave considerably better results. It is pointed out that these values are for dried forage. In grazed forage, the value is masked by high moisture content.

No. 4. Effect of Nitrogen Fertilization and Maturity on Yield, Protein, Nitrates, and Digestibility of Sudax Sorghum-Sudan Hybrid and Gahi-1 Pearlmillet

Gahi-1 pearlmillet was seeded May 20 using 20 pounds of seed per acre and Sudax at the 30-pound rate, both in 6-inch rows. Both grasses were fertilized at 80, 160, and 320 pounds nitrogen per acre, split into four applications. The millet was clipped during summer in the pre-boot stage and Sudax was cut both at pre-boot and early bloom. Harvest procedures were similar to Experiment 1.

Forage samples from each replication were kept on ice before being oven dried, and then ground and analyzed for total nitrogen and nitrate. Larger forage samples were ground and used for digestibility determinations with steers having a rumen fistula. Nylon bags containing the forage were inserted into the rumen through the fistula and left for 24 to 48 hours. Upon removal, samples were oven dried and weighed to determine percentage digestibility.

Total forage yields of millet and Sudax were similar when cut at pre-boot stage, averaging 4 tons per acre, Table 5. Sudax production was higher than millet in early and late season. Sudax yield was doubled by delaying harvest from pre-boot to early bloom stage. Both millet and Sudax made higher yields at 320-pound nitrogen rates than when 160 pounds per acre was applied. However,

TABLE 5. EFFECT OF NITROGEN FERTILIZATION AND STAGE OF MATURITY ON FORAGE YIELD, LEAVES, CRUDE PROTEIN, AND STAND OF PEARLMILLET AND SUDAX, 1965

Nitrogen per acre and harvest stage	Total dry forage per acre	Season average leaves in dry forage	Total leaves per acre	Season average crude protein	Stand of live plants, Oct. 4
	Lb.	*Pct.*	*Lb.*	*Pct.*	*Pct.*
Millet, pre-boot					
80 lb. N	7,878 b*	50	4,577	8.2	72
160 lb. N	7,721 b	58	4,951	11.2	50
320 lb. N	9,161 a	54	5,540	13.8	40
Sudax, pre-boot					
80 lb. N	6,594 b	52	3,294	11.9	35
160 lb. N	7,145 b	54	3,982	13.1	32
320 lb. N	8,484 a	54	4,517	15.6	21
Sudax, early bloom					
80 lb. N	14,018 c	32	4,215	7.3	35
160 lb. N	17,352 b	33	5,065	7.6	45
320 lb. N	19,185 a	25	4,746	7.8	60

* Least significant range. Any two means not marked with the same letter are significantly different at .05 level.

only with Sudax at bloom stage was there an increase when nitrogen rate went from 80 to 160 pounds. Similar yield responses were obtained in 1966, but drought lowered overall yields.

When cut at pre-boot stage, millet and Sudax stands declined with increasing rates of nitrogen. This probably accounts for lower yield in late summer, Table 5. A reverse situation was noted for Sudax cut at early bloom.

Leaf percentage of millet was slightly higher than Sudax in early season, but Sudax was more leafy in fall. As in Experiment 2, nitrogen fertilization had no effect on percentage leaves.

Crude protein content of Sudax was higher than millet when both were cut at pre-boot stage, Table 5. Crude protein content of millet increased with nitrogen fertilization. Similar results were obtained with Sudax cut at pre-boot stage, but at early bloom protein content remained low at all rates of nitrogen.

Nitrates reached potentially toxic levels only at the high rate of nitrogen ferti-

TABLE 6. EFFECT OF NITROGEN FERTILIZATION AND STAGE OF MATURITY ON NITRATE CONTENT OF PEARLMILLET AND SUDAX, 1965

Nitrogen per acre and harvest stage	Nitrate content in dry forage										
	June 11	June 17	June 24	July 6	July 19	July 26	Aug. 12	Aug. 25	Sept. 1	Oct. 8	Oct. 20
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Millet, pre-boot											
80 lb. N			.05				.06			.05	
160 lb. N		.11				.04			.04	.12	
320 lb. N		.28				.04		.17		.10	
Sudax, pre-boot											
80 lb. N	.06					.02			.04	.14	
160 lb. N	.39				.02			.04		.14	
320 lb. N	.81				.07			.09		.12	
Sudax, early bloom											
80 lb. N				trace				.03			.07
160 lb. N				trace			.06				.06
320 lb. N				.01			.05				.03

lization. This occurred only in early season on both millet and Sudax cut at pre-boot, Table 6. (Plants containing 0.2 per cent or more nitrogen as nitrate are considered potentially toxic for ruminant animals.) No nitrate problem occurred with Sudax cut at early bloom. Extremely dry weather in early June probably accounted for the nitrate build-up in plants at that time.

TABLE 7. EFFECT OF STAGE OF MATURITY ON DIGESTIBILITY IN RUMEN AT 24 AND 48 HOURS OF PEARLMILLET AND SUDAX, AVERAGE OF ALL HARVESTS, 1965

Forage and harvest stage	Dry matter digestibility	
	24 hours	48 hours
	Pct.	*Pct.*
Millet, pre-boot	61.7 a*	76.3 a
Sudax, pre-boot	63.1 a	76.3 a
Sudax, early bloom	55.2 b	65.5 b

* Least significant range for each column. Any two means not marked with the same letter are significantly different at .05 level.

The rate of digestion in the rumen is given by the data in Table 7. In comparing the 24-hour and 48-hour periods that samples were in the rumen, less variability between replications was obtained for the longer period. As might be expected, digestibility percentages were higher when forage samples remained in the rumen for a longer time. The seasonal decline in digestibility was greater from the 24-hour than the 48-hour rumen test period, Table 8. Rapid digestion is desirable; therefore, the 24-hour values may be a more critical evaluation of forage nutritive value.

Dry matter digestibility of the forage tested was exceptionally high and fully comparable to corn grain. Digestibility of both millet and Sudax declined over the season, Table 8. Nitrogen fertilization had no effect on digestibility.

The digestibility data suggest that animals should perform well on both of these forages. However, grazing studies with steers on millet in Alabama have resulted in daily gains of only 1 to 1.25 pounds per animal. The higher water content of these forages may be one factor, resulting in a large quantity of green forage being eaten but a relatively low intake of dry matter.

Delayed harvesting of Sudax from pre-boot to early bloom doubled the forage yield but resulted in a large decline in dry matter digestibility. Selective grazing by the animal may alter this somewhat. Early bloom forage harvested as hay could be valuable when used in a blended ration.

SUMMARY

Several experiments were conducted at the Plant Breeding Unit, Tallassee, to determine effects of various management practices on yield and nutritive values of "Sudax" SX-11 sorghum-sudan hybrid and Gahi-1 pearlmillet. Results are summarized as follows:

(1) Sudax seeded at 30 pounds per acre in 6-inch rows gave maximum for-

TABLE 8. EFFECT OF STAGE OF MATURITY AND SEASON ON DRY MATTER DIGESTIBILITY IN RUMEN AT 24 AND 48 HOURS OF PEARLMILLET AND SUDAX, 1965

Forage and harvest stage	Seasonal dry matter digestibility					
	24 hours			48 hours		
	June	July	Aug.-Sept.	June	July	Aug.-Sept.
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Millet, pre-boot	63.4 a*	60.1 a	58.7 a	78.1 a	74.5 a	72.9 a
Sudax, pre-boot	65.6 a	60.5 a	58.0 a	79.5 a	73.1 a	69.3 a
Sudax, early bloom	54.6 b	55.7 b	50.0 b	64.2 b	66.8 b	61.1 b

* Least significant range for each date. Any two means not marked with the same letter are significantly different at .05 level.

age yield. Stem diameter was similar at all seeding rates above 10 pounds per acre. Leaf percentage, crude protein, lignin, and fiber contents of the forage were generally unaffected by seeding rate.

(2) Forage yields, lignin, and fiber content of Sudax increased as plants were harvested at more advanced stages of maturity, and there was a corresponding decrease in crude protein content and leaf percentage.

(3) Crude protein content of Sudax was higher than millet at all rates of nitrogen fertilization when both forages were harvested in the pre-boot stage.

(4) Prussic acid content of Sudax was low regardless of maturity.

(5) Nitrates were at potentially toxic levels only at the highest rate of nitrogen and only in early season on both millet and Sudax when cut at pre-boot.

(6) Sudax and millet harvested at pre-boot had similar dry matter digestibility as measured by *in vivo* nylon bag method.

(7) Dry matter digestibility decreased with increasing plant maturity.

(8) Nitrogen fertilization did not affect dry matter digestibility or leaf percentage of either millet or Sudax.

(9) Digestibility determinations with lambs showed that Sudax was highly digestible, even at dough stage.

(10) Sudax and millet responded to as much as 320 pounds of nitrogen per acre, but lower rates would be more practical.