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Effects of Cultural and Management Practices on Sudangrass Performance

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Contents

Summary

Sudangrass is widely adapted in Texas and is grown extensively for grazing, hay and silage. Sudangrass-sorghum hybrids, generally crosses between a male sterile grain sorghum and a sudangrass variety, have been used widely in recent years. The hybrids generally grow faster, produce more total dry matter and recover more rapidly following harvest than the sudan varieties. General culture and management practices are similar for the varieties and hybrids.

Seeding rates and row spacings generally have little effect on total dry-matter yield of the various sudan types. Yield of the first cutting may increase with seeding rate. If the first cutting is made at a late stage of maturity, total yield may be increased to some extent by heavier seeding rate. Tillering tends to compensate for stand differences, especially after the primary growing point is removed at the first cutting.

The first-cutting yield is likely to be higher for broadcast or close-drilled planting than for row plantings. Thus, these practices are favored for hay production. Total yields, if several cuttings are made, are not significantly different with broadcast and row plantings. Generally, better distribution of the production during the growing season results from planting in cultivated rows.

Frequent harvest reduces total forage production even though more total cuttings are made. The percentage reduction from frequent harvest is greater with the hybrids than with the varieties; however, the hybrids produce more total forage at any cutting frequency. Protein content decreases with advanced stages of maturity. Thus, both maximum yield and maximum protein content cannot be obtained with the same harvest practice.

Leaf development of the sudangrass hybrids is at a maximum at an early stage of growth. After the plants are 30-36 inches high, additional growth consists mainly of stalk development and elongation. While frequent harvest reduces total plant yield, leaf yield is not reduced and may be greater with frequent harvest.

Effects of Cultural and Management Practices on Sudangrass Performance

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Sudangrass, *Sorghum sudanense* (Piper) Stapf., has been grown in Texas for more than 50 years. It is used for grazing, hay, silage, green-chop, bundle feed and as a green manure crop. Its area of adaptation extends from the arid sections of the Rolling and High Plains to the high rainfall, humid sections of East Texas and the Gulf Coast. It is broadcast, drilled and planted in cultivated rows at widely varying seeding rates.

In recent years, sudangrass-sorghum hybrids have been developed and introduced into the market. These are largely hybrids between male sterile grain sorghum lines and sudangrass varieties. These hybrids have demonstrated increased vigor over open-pollinated sudangrass varieties and have come into widespread use. Seed of the hybrids generally are round, but a wide range in seed size is found among the hybrids. Thus, the number of seed per pound also varies widely. The use, distribution and culture of the hybrids are similar to the varieties.

Research has shown that harvesting and planting practices influence the type and amount of growth produced by many forage plants. Numerous studies of seeding rates, row spacings and harvest practices have been conducted in Texas with the sudan varieties and to some extent with the hybrids. Results of these studies are reported in this publication. Results from these types of studies should provide valuable information in developing management practices for hay, silage, green-chop and other types of harvested feed operations. It should be pointed out that mechanical harvesting, especially of a tall growing plant, is not comparable to grazing, and the results cannot be interpreted specifically in terms of grazing responses. Even then, certain principles such as growth behavior patterns and potential yield differences between types developed in clipping studies may have general application.

ESTABLISHMENT PRACTICES

Seeding Rate and Row Spacing

Sweet sudangrass was planted in 40, 20 and 10-inch rows at McGregor at rates ranging from 4 to 32 pounds of seed per acre. Two harvests were made: the first in the flowering stage and the second at the end of the season. Average production for a 3-year period is given in Table 1. In general, these results indicate very little effect of seeding rate on total forage production. The only major difference in yield was with the 32-pound seeding rate in 10-inch rows which produced considerably more forage than any other treatment. This difference was primarily in increased yield at the first cutting, which in this study was made rather late. The first cutting contributed approximately 75 percent of the total yield, regardless of the method or rate of seeding.

Sudangrass has the capacity to adjust or compensate for stand, especially within the row, through tillering. Thin stands will develop more tillers than thick stands. Since most of the tillering occurs after the primary growing point is removed, the late initial harvest

TABLE 1. THE EFFECT OF ROW SPACING AND SEEDING RATE ON SWEET SUDANGRASS FORAGE PRODUCTION, McGREGOR, 1960-62 (3-YEAR AVERAGE)

Row spacing (inches)	Seeding rate (pounds per acre)	Pounds of dry forage per acre First cutting	Total yield
40	4	3,780	5,350
	8	4,040	5,610
Average		3,910	5,480
20	4	4,130	5,730
	8	4,160	5,560
	16	4,430	5,720
	32	4,740	6,160
Average		4,360	5,790
10	4	4,930	6,680
	8	4,980	6,660
	16	4,730	6,120
	32	5,920	7,510
Average		5,140	6,740

in this study allowed less opportunity for tillers to exert an influence on yield. This probably accounts for the increased yield of the heavy seeding rate in 10-inch rows. These data indicate that sudan may be established with light seeding rates, even in narrow rows, and yet produce a satisfactory yield.

There was some yield advantage to narrow rows at McGregor, both in 1962 which was a dry year and in 1961 which was a very favorable year. The effect is expressed almost completely in the first cutting, at which time tillering had not developed to any extent. First-cutting yield was much higher in 10-inch rows with 4 and 8 pounds of seed per acre than in wider rows at the same seeding rates. This indicates that either less competition occurred within the narrow row because of greater spacing between plants, or more tillering occurred because of the greater spacing, or a combination of the two factors helps to produce the higher yields.

Earlier work at College Station (Table 2) had indicated better yield in row plantings. In the College Station study, four harvests were made in the boot stage. When the tops (growing points) are removed, tillering is enhanced. Cultivation improves aeration and water penetration. These factors favor row plantings, whereas yields are generally better with close-drill or broadcast plantings at the initial harvest or with a single harvest at a later stage of maturity.

Increased seeding rates also may increase yields at the initial harvest. In 1956 at College Station, there was almost a straight line increase in first-cutting yield with increased seeding rates from 7 to 50 pounds of seed per acre (Figure 1). However, when several cuttings are made in the boot stage or earlier, seeding rates have relatively little effect (Table 2). The response to seeding rate was somewhat erratic in this study. Differences

TABLE 2. FORAGE YIELD OF IRRIGATED SWEET SUDANGRASS, ON LUFKIN FINE SANDY LOAM SOIL NEAR COLLEGE STATION, 1955-56

Seeding method	Pounds of seed per acre	Pounds of air-dry forage per acre 1955[1]	1956[2]	Average 1955-56
40-inch row	7	4,790	6,390	5,590
	14	7,100	6,580	6,840
	21	6,220	6,930	6,575
	28	6,090	5,950	6,020
Average		6,050	6,460	6,255
Broadcast	20	4,990	5,010	5,000
	30	5,420	4,480	4,950
	40	5,790	5,250	5,520
	50	6,330	5,220	5,775
Average		5,630	4,990	5,310

[1]The difference in yield between any two seeding rates must equal or exceed 845 pounds to be significant (.05 level).

[2]Difference in average yield of the two seeding methods was significant statistically (.05 level), but differences due to seeding rates were not significant.

in yield due to seeding rates were significant statistically in 1955 but not in 1956.

These results suggest that method and rate of seeding are dictated to some extent by the intended use. Heavier seeding rates and closer row spacings favor first-cutting yields which would be desirable in a hay operation. Wider row spacings with cultivation result in better regrowth and possibly better total yields and would be favored for grazing where sustained production is desired.

Single Versus Double Rows

Two methods of planting in basic 40-inch rows were studied at Temple in 1964. A sudangrass-sorghum hybrid was planted in single 40-inch rows and in twin rows 12 inches apart with the main rows on 40-inch

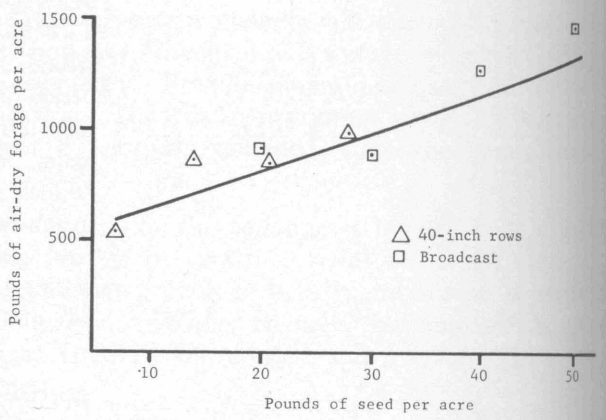

Figure 1. The relationship of seeding rate to first-cutting yield of sweet sudangrass.

TABLE 3. THE EFFECT OF METHOD AND RATE OF SEEDING COMMON SUDANGRASS ON FORAGE PRODUCTION, TEMPLE, 1964

Method of seeding[1]	Seeding rate (pounds per acre)	Pounds of dry forage per acre		
		July 6	October 20	Total
Single row	10	4,880	3,000	7,880
Double row	10	5,510	3,250	8,760
Double row	15	5,640	2,180	7,820

[1]Main rows were on 40-inch centers.

centers. In addition, two seeding rates were employed in the double rows. The seeding was made May 11, 1964, and harvests were on July 6 and October 20. The results in Table 3 indicate that seeding in a double row tended to increase yield, even though the same amount of seed was used as in a single row. In fact, there was no advantage to increasing the seeding rate in double rows above the 10 pounds per acre used in single rows.

Seeding Rate and Harvest Frequency

Haygrazer, a sudangrass-sorghum hybrid, was planted at College Station on May 13, 1964 in 12-inch rows. The plot was fertilized with 42-42-42 at planting and topdressed with 40 pounds of nitrogen per acre in early July. Harvests were made in the early boot stage, early flower stage and hard dough stage. It is apparent (Table 4) that when harvest is initiated in the young or immature stage that heavy seeding rates are not necessary. Only with harvesting in the mature stage did seeding rate have any effect. This is similar to the response at McGregor in 10-inch rows where the harvest also was made in a mature stage of growth.

Boot stage yields actually were higher in this case than flower stage, possibly because of timing of the flower stage harvest which did not permit enough regrowth following the second harvest for a third harvest. Very good yields were produced with all treatments.

TABLE 5. THE INFLUENCE OF STAGE OF MATURITY AT HARVEST AND HEIGHT OF CUTTING ON FORAGE YIELD OF TWO SUDANGRASS TYPES, NEAR COLLEGE STATION, 1961-62

Stage of maturity when harvested	Pounds of dry forage per acre at different cutting heights		
	6 inches	12 inches	Average[1]
		Sweet sudan	
24 to 36 inches high	5,540	5,620	5,580
Booting	5,760	7,330	6,540
Flowering	7,590	7,700	7,640
Average (Sweet sudan)[1]	6,300	6,880	6,590
		Sudax 11	
24 to 36 inches high	7,650	7,190	7,420
Booting	9,340	9,100	9,220
Flowering	10,280	11,500	10,890
Average (Sudax 11)[1]	9,090	9,260	9,180

[1]The differences in average yield between varieties and among stages of maturity were significant statistically.

HARVEST PRACTICE

Height and Frequency

Sweet sudangrass and Sudax 11, a sudan-sorghum hybrid, were planted in 40-inch rows at the rate of 10 pounds of seed per acre on Brazos river bottom soil (Miller clay) in early April in 1961 and 1962. The plot area received 40 pounds per acre of nitrogen prior to planting and 40 pounds in early July. Harvests were made at three stages of maturity and with two stubble heights. The stages of maturity and stubble heights are given in Table 5. The stage of maturity was based on 50 percent or more of the plants having reached the stage indicated. A 9-inch stubble height was included in 1961 and an 18-inch stubble height in 1962, but only the two heights common to both years are reported. Yields resulting from the treatment combinations are given in Table 5.

TABLE 4. THE EFFECT OF SEEDING RATE AND FREQUENCY OF HARVEST ON HAYGRAZER FORAGE YIELD NEAR COLLEGE STATION, 1964

Stage of maturity at harvest	Pounds of seed per acre[1]	Pounds of dry forage per acre							
		June 24	July 9	July 13	July 17	August 7	September 9	October 7	Total
Boot stage	20	4,830		2,710		930		3,600	12,070
	50	4,250		3,030		650		3,290	11,220
Flower stage	20		5,070				5,390		10,460
	50		3,990				5,700		9,690
Hard dough stage	20				7,890			7,480	15,370
	50				10,570			6,740	17,310

[1]Haygrazer, a sudangrass-sorghum hybrid, established in 12-inch rows. Differences in total yield due to stage of maturity were significant statistically, but the two seeding rates did not differ significantly.

TABLE 6. THE EFFECT OF HARVEST PRACTICE ON SUDAX 11 FORAGE YIELD, COLLEGE STATION, 1964

Stage of growth at harvest	Method of harvest	Pounds of dry forage per acre							
		June 24	June 29	July 8	July 17	August 12	September 8	October 8	Total
30 inches high	Plants cut	2,300			1,310	840		1,230	5,680
	Leaves removed[1]	1,160			720	260		4,500[2]	6,640
Boot	Plants cut		3,940			3,300		1,730	8,970
	Leaves removed[1]		1,350			650		5,560[2]	7,560
Flower	Plants cut			5,730			4,500[2]		10,230
	Leaves removed[1]			1,130			540	4,500[2]	6,170

[1]All leaves were removed from the plants, but the stems were left standing. Harvests were made at the time plants were cut.
[2]The whole plant was cut at the last harvest.

Yields were significantly reduced by harvesting sudan in immature stages. Each later stage represents approximately 2 weeks in time on the average. Sweet sudan increased in total yield about 1,000 pounds per acre with each 2-week delay of harvest. Sudax 11, which has a higher potential yielding ability, increased over 1,600 pounds with each 2-week delay of harvest.

At the most frequent harvest, Sudax 11 yielded approximately 1,800 pounds of dry matter per acre more than Sweet sudan. When harvested in the flowering stage, the yield of Sudax 11 was over 3,200 pounds more than Sweet sudan. These data indicate that practices which restrict or limit yield have a greater effect on types with greater potential.

Height of cutting had less effect on yield than either the frequency of cutting or variety. Sweet sudan appeared to be favored by the 12-inch stubble height. The 12-inch stubble height produced more with each frequency than the 6-inch height. On the other hand, Sudax 11 showed no consistent response to height of cutting, and the average of the two heights differed less than 200 pounds per acre.

In the second year of this study, an 18-inch stubble height was included which is not shown in the 2-year summary table. Average yields for the 6, 12 and 18-inch heights were 7,740, 8,290 and 7,080 pounds of dry matter per acre, respectively. Thus, it is apparent that heights above 12 inches result in a reduction of total dry matter.

Method of Harvest

Sudax 11 was seeded May 13, 1964 in 40-inch rows at the rate of 10 pounds per acre on Brazos bottom Miller clay soil. The test was fertilized with 42-42-42 at planting and topdressed with 40 pounds of nitrogen per acre in early July. Two methods of harvesting forage were utilized, each at three stages of maturity.

(1) 30-inch growth — When initial growth was 30 inches high, one set of plots was cut and another set was stripped of leaves. When regrowth on the cut plots again reached 30 inches, both the "cut" and "stripped" plots were again harvested in a similar fashion. Plants on stripped plots were cut at the final harvest and separated into leaves and stems.

(2) Boot stage — The procedure was the same as for the "30-inch" plots except that harvesting was done when regrowth on "cut" plots reached the boot stage.

(3) Flower stage — The same procedure was used as for the "30-inch" plots, except that harvesting was done when regrowth on "cut" plots reached the bloom stage.

The effect of harvest practice on total forage yields and distribution of yield during the season is presented

TABLE 7. THE EFFECT OF HARVEST PRACTICE ON LEAF YIELD OF SUDAX 11, COLLEGE STATION, 1964

Stage of growth at harvest	Method of harvest	Pounds of dry leaves per acre							
		June 24	June 29	July 8	July 17	August 12	September 8	October 8	Total
30 inches high	Plants cut	1,160			580	380		530	2,650
	Leaves removed[1]	1,160			720	260		390	2,530
Boot	Plants cut		1,350			1,170		610	3,130
	Leaves removed[1]		1,350			650		380	2,380
Flower	Plants cut			1,130			1,580		2,710
	Leaves removed[1]			1,130			540	250	1,920

[1]All leaves were removed from the plants, but the stems were left standing. Harvests were made at the time plants were cut.

in Table 6. It is apparent that when the whole plant was removed, yields increased with each advanced stage of maturity. On the other hand, if only the leaves were removed during the growing season, the stage of maturity at which this was done initially had little influence on total plant growth.

Leaf growth appears to have reached a near maximum by the time the plants were 30 inches high (Table 7). Leaf yield increased only 190 pounds with a delay in initial harvest from June 24 to 29. A further delay to July 8 actually resulted in some loss of leaf weight, probably through shedding. Since new leaf growth on uncut plants developed primarily with stem elongation above the previous leaf level, leaf yield with each succeeding harvest decreased. Actually the same pattern of decrease in leaf yield also occurred on the plants cut in the younger stages.

Total leaf yields were remarkably similar with all methods and stages of harvesting. The poorest leaf yield was with leaf stripping at the most advanced stage of maturity, and the best yield was with total plant harvest in the boot stage.

These data indicate that harvesting sudangrass prior to the flower stage reduces total yield primarily by restricting stalk development. Maximum leaf development is reached considerably before this stage, and total leaf yield is influenced relatively little by harvest practice. Removal of the leaves only, as may occur under grazing at more advanced stages of maturity, does not greatly influence either leaf or total plant yield. However, new leaves are formed primarily above the earlier leaves, making them less accessible. As the stalk matures, it is less useful as forage.

If the primary growing point is not removed, as in stripping, tillering is inhibited; thus, yield may be less than with cutting. This is especially true with harvesting at the more advanced stages of maturity. Frequent removal of the growing point, as in the 30-inch cut, restricts total yield more than leaf yield because a greater part of the total plant weight is in the stalk.

Frequently, the leaves of sudangrasses are removed by grazing animals, leaving only the bare stem. The above results suggest occasional removal of these defoliated stems to encourage new tiller development and the development of more accessible leaves. For hay or harvested forage, harvesting in the boot or later stage is indicated for best production even though maximum leaf development has already occurred.

Frequency of Harvest

Several sudan varieties, sudan-sorghum hybrids and short lived perennial types were grown at Temple on Houston clay in 1960 and 1961 and harvested at three stages of maturity. In addition to determining yield, the forage was analyzed for protein content. Yield results are recorded in Table 8. It is obvious that the two hybrids were considerably higher yielding than the varieties, and that the perennial types performed about the same as the annual varieties.

Forage yields of the varieties harvested in an immature stage, prior to booting, resulted in approximately 50 percent as much forage as harvesting in the hard dough stage. The hybrids produced only 35 percent as much forage when harvested in the immature stage as with late maturity. Yet the yields of the hybrids were greater than the yields of the varieties, even with early harvesting. Thus, the potenial of the higher yielding hybrids is limited more by early frequent harvesting than is the potential of the varieties or perennial types. The variety yields averaged approximately 75 percent of the hybrid yields with frequent harvest but only 50 percent with harvest in the hard dough stage.

TABLE 8. THE EFFECT OF STAGE OF MATURITY AT THE TIME OF HARVEST ON YIELD OF FORAGE, TEMPLE, 1960-61

Variety or hybrid	Tons of dry forage per acre								
	Preboot stage[1]			Boot stage[1]			Hard dough stage[1]		
	1960	1961	Average	1960	1961	Average	1960	1961	Average
Variety									
Greenleaf	1.7	1.9	1.8	4.1	1.9	3.0	3.8	3.9	3.9
Piper	1.7	2.3	2.0	4.5	2.3	3.4	3.8	4.2	4.0
Sweet	1.4	1.7	1.6	4.0	1.6	2.8	3.4	2.8	3.1
Common	1.9	1.9	1.9	3.9	2.2	3.1	3.0	3.3	3.2
Hybrid									
Sudax 11	2.2	2.8	2.5	5.9	3.0	4.5	5.8	7.8	6.8
Grazer		2.3			2.7			6.3	
Weak perennial									
Perennial Sweet	1.1	1.6	1.4	3.4	1.5	2.5	3.6	3.8	3.7
Sorghum almum	1.7	2.0	1.9	4.1	2.0	3.1	3.9	4.6	4.3

[1]Stage of maturity each time the plants were harvested.

TABLE 9. THE EFFECT OF STAGE OF MATURITY AT THE TIME OF HARVEST ON PERCENT PROTEIN IN THE FORAGE, TEMPLE, 1961

Variety or hybrid	Preboot stage[1]						Boot stage[1]					Hard dough stage[1]			
	May 30	June 19	July 20	Aug. 24	Nov. 4	Avg.	June 5	July 6	Aug. 8	Sept. 26	Avg.	June 23	Aug. 21	Nov. 7	Avg.
Variety															
Greenleaf	14.2	11.6	7.8	7.0	8.4	9.8	9.1	9.8	6.9	7.4	8.3	10.4	3.9	8.2	7.5
Piper	13.4	12.9	7.2	5.2	8.3	9.4	15.9	8.0	6.2	7.8	9.5	7.4	3.1	8.0	6.5
Sweet	14.0	12.4	8.8	8.1	9.3	10.5	11.7	8.5	7.5	7.7	8.9	7.1	3.4	8.7	6.4
Common	12.7	11.2	7.5	6.2	9.8	9.5	11.1	7.6	7.4	7.1	8.3	6.1	4.9	8.1	6.7
Hybrid															
Sudax 11	14.3	14.4	8.6	6.3	8.0	10.3	9.2	9.3	6.0	6.7	7.8	7.8	3.8	6.3	6.0
Grazer	12.2	12.3	7.8	5.7	8.9	9.4	7.9	9.9	6.1	7.1	7.8	5.6	3.0	6.3	5.0
Weak perennial															
Perennial Sweet	15.5	12.9	7.5	6.7	9.3	10.4	13.7	10.5	8.4	8.3	10.2	9.2	3.1	7.7	6.7
Sorghum almum	14.7	12.9	8.8	6.7	9.0	10.4	14.2	7.4	6.8	7.3	8.9	7.0	3.8	7.6	6.1

[1]Stage of maturity each time the plants were harvested.

Protein content was determined in both 1960 and 1961 and followed a similar pattern in both years. The 1961 data are shown in Table 9. Protein content decreased with advancing maturity as expected. Differences either among or within the varieties, hybrids and perennial types were small for any harvest date or the average for the season. There was some indication that the higher yielding hybrids were lower in protein than the varieties at the later stages of maturity, especially late in the season. This might be expected as a result of the greater production of the hybrids, especially if the nitrogen supply in the soil was limited.

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