Performance of F1 Hybrids from Crosses of Three Sudangrasses and Six Forage Sorghums with A Rhodesian Sudangrass

Antonio Sotomayor-Rios and Alma Santiago

ABSTRACT

A cytoplasmic male-sterile sudangrass (A Rhodesian) was crossed with three other sudangrasses (Common, Greenleaf, and Piper) and six forage sorghums (Sart, Millo Blanco, Bloomless, Forage Sorgo × Sugar Drip, Collier, and Brawley). The nine F1 hybrids were compared for yield of green forage (GF), yield of dry forage (DF), crude protein (CP) content, CP yield, and height at Isabela, Puerto Rico. Four cuttings were made. The first was 45 days after planting and the remaining three were at about 30-day intervals thereafter. The second harvest had the highest DF yield but the lowest CP content. The CP content was 15.7, 12.2, 14.6, and 15.6% for harvests 1, 2, 3, and 4, respectively. When data for all four harvests were combined, the F1 hybrid of A Rhodesian sudangrass × Common produced the highest GF and DF yields, 143 kg·ha⁻¹·day⁻¹ of the latter which was 30% and 29% more than the 2nd- and 3rd-highest DF producing hybrids. Differences in CP content among the nine F1 hybrids were not significant, but A Rhodesian sudangrass × Common produced the highest CP yields. The tallest F1 hybrids were A Rhodesian × Common and A Rhodesian × Greenleaf. The GF and DF yields of A Rhodesian × Common were excellent. The results indicated that A Rhodesian sudangrass is a male-sterile line with potential for use in the development of superior F1 forage-sorghum hybrids in Puerto Rico.

INTRODUCTION

In the United States, forage sorghums (Sorghum bicolor (L.) Moench) are grown as “summer annual crops.” About 25% of the total sorghum hectarage grown in the United States is forage sorghum; the other 75% is grown for grain or seed (2).

In Puerto Rico, forage sorghums have a great potential for production throughout the year, but few reports are available concerning the use of this crop, which at present is limited mainly to some plantings in the northern and southwestern parts of the island. The literature on such use is not extensive. Vázquez et al. (7) reported DF yields of over 35 tons per hectare with Millo Blanco, a local forage-sorghum variety. Sotomayor-Rios and Telek (6) obtained DF yields of about 17 tons with hybrid CK-60 × Millo Blanco, with an average crude protein content of 17.6%, during a 211-day period at Isabela. Morales (3), evaluating a series of forage-sorghum hybrids and sorgo-sudan hybrids at Isabela, reported yields of over 40 tons of DF/ha yearly when the forage was harvested at 45 days.

In Hawaii, Plucknett et al. (4) reported that yields from forage sor-
Sorghums were excellent in lowland and coastal areas, but fair to poor in higher, cooler areas.

This study was conducted in order to evaluate the performance in northwestern Puerto Rico of nine F_1 hybrids for which line A Rhodesian sudangrass, a cytoplasmic male-sterile line, was the female parent. Line A Rhodesian was developed from Rhodesian sudangrass (P.I. 156549) and Combine Kafir-60 (CK-60) by Craigmiles in Georgia (1). It was developed by a series of backcrosses in which CK-60 cytoplasmic male-sterile factors were transferred to Rhodesian sudangrass.

MATERIALS AND METHODS

In 1976, hand crosses were made between A Rhodesian sudangrass and three other sudangrasses (Piper, Common, Greenleaf) and between A Rhodesian sudangrass × six forage sorghums (Sart, Millo Blanco, Bloomless, Collier, Brawley, and Forage Sorgo × Sugar Drip). Bloomless forage-sorghum seed was supplied by Dr. Dale Weibel of Oklahoma State University; the remaining sudangrasses and forage sorghums are well-known varieties for which seed is readily available.

The experiment was conducted at the Isabela experiment farm of MITA, AR-SEA-USDA, in northwestern Puerto Rico. The farm is 128 m above sea level, and temperatures range from 18° to 31° C. The soil is a Coto clay (Oxisol) with pH ranging 5.0 to 5.5. The nine F_1 hybrids were planted (with the aid of a small tractor) April 4, 1977. The seeding rate was about 12 kg/ha. Immediately after planting, propazine\(^3\) [2-chloro-4,6-bis(isopropylamino)-s-triazine] was applied for weed control to all plots at 2 to 3 kg of active ingredient/ha. Two weeks after planting, a complete fertilizer (15-5-10) was applied to all plots at about 560 kg/ha.

A complete block design with four replications was used. Plots consisted of two rows spaced 101 cm apart and 5 m long. Sampling area was 4 m\(^2\). The first cutting was made 45 days after planting and subsequent harvests were made about every 30 days thereafter. After each of the four cuttings and throughout the duration of the experiment, N at the rate of about 83 kg/ha in a 15-5-10 fertilizer was applied to all plots. Overhead irrigation was applied whenever necessary.

Before each cutting, plant height from the ground to the midpoint of the last leaf was measured for two plants per plot, chosen at random, in all treatments. Yield of green forage (GF) per plot was calculated for each harvest. Samples were analyzed for DF and CP content at MITA labo-

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\(^3\) Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.
ratories. Data were subjected to analysis of variance, and significant differences were identified with Duncan’s multiple range test.

RESULTS AND DISCUSSION

Table 1 shows the mean GF yield, DF yield, CP yield, CP content, and height across the nine F1 hybrids at each harvest. The forage yields were usually highest at harvest 2, but the CP content was the lowest at this stage. The wide range in production at each harvest was due to the great variability among F1 hybrids. Yields of GF and DF in harvests 3 and 4 were very similar. In general, the plants were tallest at harvest 2; thus the greatest height coincided with the highest GF and DF yields.

Table 2 shows the mean yields, CP content, and height for each of the nine F1 hybrids across the four harvests. The GF yields ranged from 126,375 to 51,125 kg/ha. The F1 hybrid of A Rhodesian × Common sudangrass produced the highest GF yield, although this was not significantly different from that of A Rhodesian × Sart. The F1 hybrid of A Rhodesian × Piper sudangrass produced the lowest GF yield.

The F1 hybrid of A Rhodesian × Common sudangrass produced the highest DF yields, significantly higher than those of the remaining eight F1 hybrids. This hybrid produced 29% and 30% more than A Rhodesian × Sart and A Rhodesian × Greenleaf the 2nd and 3rd highest DF producers, respectively. The DF yields of A Rhodesian × Common are excellent compared with those of perennial tropical grasses. At Isabela, Sotomayor-Rios et al. (5) studied the effect of harvest intervals on 10 forage grasses. At the 30-day interval, the best yielder, Transvala digitgrass (Digitaria decumbens Stent), produced about 29,000 kg/ha in 1 year, whereas A Rhodesian × Common sudangrass produced almost 69%
of that yield in only 140 days. In Hawaii the DF yield of Haygrazer, a high-yielding forage sorghum, was reported to be 134 kg·ha\(^{-1}\)·day\(^{-1}\) (4), whereas the yield of A Rhodesian × Common sudangrass in this study was 143 kg·ha\(^{-1}\)·day\(^{-1}\).

No significant differences in CP content were observed among the nine F\(_1\) hybrids. The average was 14.5%. This value is lower than that reported by Sotomayor-Ríos and Telek (6) for Redlan × Millo Blanco when this F\(_1\) hybrid was evaluated at Isabela during a 211-day period.

The CP yields of the nine F\(_1\) hybrids ranged from 2,712 to 1,391 kg/ha. The F\(_1\) hybrid of A Rhodesian × Common produced the highest CP yield,

<table>
<thead>
<tr>
<th>Male parent of hybrid</th>
<th>Green forage yield Kg/ha</th>
<th>Dry forage yield Kg/ha</th>
<th>Crude protein yield %</th>
<th>Crude protein content Kg/ha</th>
<th>Height Cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common sudangrass</td>
<td>126,375 a</td>
<td>20,039 a</td>
<td>14.3</td>
<td>2,712 a</td>
<td>148 a</td>
</tr>
<tr>
<td>Sart sorghum</td>
<td>101,687 ab</td>
<td>15,362 b</td>
<td>14.2</td>
<td>2,124 ab</td>
<td>137 bc</td>
</tr>
<tr>
<td>Greenleaf sudangrass</td>
<td>90,563 bc</td>
<td>15,591 b</td>
<td>14.4</td>
<td>2,199 ab</td>
<td>141 ab</td>
</tr>
<tr>
<td>Brawley sorghum</td>
<td>88,813 bc</td>
<td>14,679 b</td>
<td>14.7</td>
<td>2,120 ab</td>
<td>119 e</td>
</tr>
<tr>
<td>Millo Blanco sorghum</td>
<td>86,500 bc</td>
<td>13,723 b</td>
<td>14.4</td>
<td>1,948 b</td>
<td>126 de</td>
</tr>
<tr>
<td>Bloomless sorghum</td>
<td>82,750 bc</td>
<td>13,578 b</td>
<td>14.8</td>
<td>1,988 b</td>
<td>127 de</td>
</tr>
<tr>
<td>Forage Sorgo × Sugar</td>
<td>81,938 bc</td>
<td>13,631 b</td>
<td>13.8</td>
<td>1,830 b</td>
<td>134 bcd</td>
</tr>
<tr>
<td>Drip</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collier sorghum</td>
<td>71,625 c</td>
<td>11,543 bc</td>
<td>15.0</td>
<td>1,705 b</td>
<td>129 cde</td>
</tr>
<tr>
<td>Piper sudangrass</td>
<td>51,125 d</td>
<td>9,464 c</td>
<td>15.2</td>
<td>1,391 c</td>
<td>110 f</td>
</tr>
</tbody>
</table>

\[\bar{X} \quad 86,820 \quad 14,179 \quad 14.5 \quad 2,002 \quad 130\]

C.V. 19.5\% 18.7\% 7.4\% 20.2\% 5.1\%

\(^1\) Data are means across four replicate plots and four harvests. In each column, means followed by one or more letters in common do not differ significantly (P = .05), according to Duncan's multiple range test.

\(^2\) Differences were nonsignificant.

but this was not significantly different from those of A Rhodesian × Sart, A Rhodesian × Greenleaf, and A Rhodesian × Brawley. A Rhodesian × Piper had the lowest CP yield.

The F\(_1\) hybrids of A Rhodesian × Common sudangrass and A Rhodesian × Greenleaf were, on the average, the tallest of all hybrids at 148 and 141 cm, respectively. These were significantly taller than the other hybrids.

It can be concluded that A Rhodesian sudangrass is a male-sterile line with potential for use in the development of forage hybrids. When this line was crossed with Common sudangrass, the F\(_1\) hybrid gave the outstanding yield of more than 20,000 kg/ha of DF in 140 days or 143 kg·ha\(^{-1}\)·day\(^{-1}\), with an average CP content of about 14.3, based on cutting at 30-day intervals.
RESUMEN

En la finca experimental MITA de Isabela, Puerto Rico, el pasto sudán androestéril, A Rhodesian, se cruzó con tres pastos sudán (Common, Greenleaf y Piper) y con seis sorgos forrajeros (Sart, Millo Blanco, Bloomless, Forage sorgo × Sugar Drip, Collier y Brawley). Los nueve híbridos F₁ se evaluaron en términos de forraje verde (GF), materia seca (DM), y proteína bruta (CP), y altura durante 140 días. El estudio se llevó a cabo en un Oxisol en la zona noroeste de Puerto Rico. Se llevaron a cabo cuatro cortes; el primero a los 45 días después de la siembra y subsiguientemente cada 30 días, aproximadamente.

Al combinar los cuatro cortes, la producción de GF y DF del híbrido A Rhodesian sudán × Common, fue 30% y 29% mejor que los de A Rhodesian × Sart y A Rhodesian × Greenleaf. No se observaron diferencias significativas entre los nueve híbridos en términos de CP, pero la producción de CP fue significativamente más alta en el híbrido A Rhodesian × Common, con 2712 kg/ha.

Los híbridos A Rhodesian × Common y A Rhodesian × Greenleaf fueron en promedio los más altos. Se concluye que el pasto sudán androestéril A Rhodesian, es una línea prometedora con magníficas potencialidades para ser utilizada en el desarrollo de híbridos forrajeros. La producción de DF del híbrido F₁ A Rhodesian × Common de sobre 20,000 kg/ha en un período de 140 días o de 143 kg·ha⁻¹·día⁻¹ con una CP de 14.3% es excelente, especialmente cuando el pasto puede ser cosechado en los trópicos cada 30 días.

LITERATURE CITED