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AGRONOMIC COMPARISON OF THREE Pennisetum INTERSPECIFIC HYBRIDS AND FORAGE SORGHUM MILLO BLANCO IN PUERTO RICO

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ABSTRACT

Napiergrass (*Pennisetum purpureum* Schumach.) (2n=28) has proven to be an excellent male parent in crosses with cytoplasmic male-sterile lines of pearl millet (*P. glaucum* (L.) K. Schum.) (2n=14) for the development of superior interspecific *Pennisetum* forage hybrids (IPFH). These hybrids (3x=21) are sexually propagated and combine the leafiness and forage quality of pearl millet with the high dry matter yield and perennial nature of napiergrass. Three IPFH (101, 102, and 103 developed by W. H. Hanna) and local photoperiod-sensitive forage sorghum Millo Blanco (*Sorghum bicolor* (L.) Moench) were compared at cutting intervals (CI) of 45, 65, and 85 days, equivalent to seven, five, and four harvests, respectively, at two locations (Oxisol and Ultisol) in Puerto Rico. Across locations, dry forage yields (DFY) of the IPFH averaged 6.0, 10.4, and 16.0 t ha\(^{-1}\) at the 45-, 65-, and 85- day CI, respectively, representing 119, 79, and 127% more DFY than that of Millo Blanco. From the data obtained, it appears that the optimum time for harvesting these grasses is 65 days. At this stage, the DFY were 5.8, 9.5, 11.4, and 10.3 t ha\(^{-1}\) for Millo Blanco and the three IPFH, respectively.

The *in vitro* dry matter digestibility for the same CI ranged from 42 to 52% and the crude protein content from 6 to 11%. The perennial nature of the interspecific hybrids plus their production of excellent quality forage attest to their potential as valuable new forage grasses for the tropics.

INTRODUCTION

Napiergrass (*Pennisetum purpureum* Schumach.) (2n=28), a perennial tropical cultivar has a yield potential of more than 35 t ha\(^{-1}\) yr\(^{-1}\).
of dry forage under intensive management practices (7). It is propagated by stem cuttings, and its digestibility is somewhat lower than that of other tropical grasses grown under similar conditions. However, napiergrass pollen can be utilized for the development of interspecific *Pennisetum* forage hybrids (IPFH) (3x=21) in combination with a cytoplasmic male-sterile pearl millet (*P. glaucum* (L.) K. Schum.) line. The resulting hybrids combine the leafiness and forage quality of pearl millet with the high dry matter yield and perennial nature of napiergrass.

This study compared the agronomic response and in vitro dry matter digestibility (IVDMD) of three IPFH and local forage sorghum Millo Blanco (*Sorghum bicolor* (L.) Moench) grown on an Oxisol and an Ultisol and harvested at three cutting intervals (CI) in Puerto Rico. Millo Blanco was selected since it is propagated by seed and has high-yielding ability and excellent forage characteristics comparable to those of the IPFH (2-5).

**MATERIALS AND METHODS**

The experiments were conducted at the Isabela (Lat. 18° 30' N, Long. 67°W) and Mayagüez (Lat. 18° 7' N, Long. 67°W) farms of the Tropical Agriculture Research Station (TARS), USDA, ARS, in Puerto Rico. Elevation above mean sea level at Isabela is 128m while at Mayagüez it is only 10 m. Temperature at Isabela ranges from 18.8 to 29.4°C; at Mayagüez, from 22.2 to 26.1°C. Mean annual rainfall at Isabela is 1675 mm; at Mayagüez, 2158 mm. The soil at Isabela is an Oxisol of the Coto series (Tropeptic Haplorthos) with 2.5% organic matter, 23 meq/100g exchange capacity, a pH of 5.0, and P, K, and NO₃ of 53, 140; and 10 ppm; respectively. The soil at Mayagüez is an Ultisol of the Consumo series (Dystropeptic Tropudults) with 3.2% organic matter, 23 meq/100 g exchange capacity, a pH of 4.8 and P, K, and NO₃ of 3, 194, and 8 ppm, respectively.

The IPFH (labeled 101, 102, and 103) were developed at Tifton, Georgia by Hanna (1). Millo Blanco is a local cultivar which has received considerable attention in Puerto Rico (2-5).
Each plot consisted of three rows 5 m long spaced 0.9 m apart. The experimental design was a randomized complete block in a split-plot arrangement with four replications. Main plots were the three IPFH and Millo Blanco (genotypes) and subplots, the three CI. Seven, five, and four harvests were made at 45-, 65-, and 85-day intervals, respectively.

Immediately after planting, propazine (2-chloro-4,6-bis (isopropylamine)-s-triazine) was applied at a rate of 2.5 kg of ai. ha\(^{-1}\) to control weeds. At planting and after each cutting, 560 kg ha\(^{-1}\) of 15-5-10 fertilizer were applied to all plots. Plants were irrigated as needed to prevent moisture stress. Before each cutting, plant height (PHt) (from the ground to the midpoint of the upper leaf blade) was measured taking five plants at random from the middle row of each plot. Yield of green forage (GFY), dry matter (DMY), and crude protein (CPY) was calculated for each cutting.

Samples were used for determination of dry matter content, (DMC), crude protein content (CPC), and in vitro dry matter digestibility (IVDMD) (6). All data were statistically evaluated by analyses of variance and treatment means were compared by Duncan's new Multiple Range Test.

RESULTS AND DISCUSSION

Significant differences between locations (L) and among genotypes (G) and cutting intervals (CI) were found for most traits (Table I). The overall DMY of the four grasses was higher at Mayagüez (Ultisol) than at Isabela (Oxisol) and increased significantly with CI (Fig. 1). The DMY of IPFH 102 was higher than that of the remaining genotypes at both locations and all CI except at 85 days at Mayagüez. At Mayagüez the DMY of this hybrid increased from 7.7 (45 day CI) to 17.8 t ha\(^{-1}\) (85 day CI) (slope = 0.2525 t d\(^{-1}\) ha\(^{-1}\)) while that of Millo Blanco increased from 3.1 (45 day CI) to 7.8 t ha\(^{-1}\) (85 day CI) (slope = 0.1175 t d\(^{-1}\) ha\(^{-1}\)). The total DMY of Millo Blanco and IPFH 102 for a 325-day growth period (65-day CI) was 36 and 61 t ha\(^{-1}\), respectively. These yields are comparable to those of best
tropical forage grasses when harvested at similar CI in Puerto Rico (3).

The overall CPY of the four genotypes was higher at Mayagüez and followed a similar trend to that of their DMY data (Fig. 2). At Mayagüez, the mean CPY of IPFH 102 increased from 0.81 to 1.09 t ha\(^{-1}\) from the 45- to the 85-day CI (slope = 0.007 t d\(^{-1}\) ha\(^{-1}\)). Millo Blanco had a similar CPY at all CI at both locations. The CPY of Millo Blanco and IPFH 102 at the 65-day CI (five cuttings) was 2.4 and 4.4 t ha\(^{-1}\), respectively. At Isabela, similar CPY for the two genotypes was observed.

At Mayagüez over CI, CPC decreased from 18.0 to 6.2 percent (Millo Blanco) (slope = -0.30\% /day) and 10.9 to 5.8 percent (IPFH average) (slope = -0.13\% /day) (Fig. 3). At Isabela, CPC decreased from 10.3 to 5.5 percent (Millo Blanco) (slope = -0.12\% /day) and 8.9 to 5.7 percent (IPFH average) (slope = 0.08\% /day) (Fig. 3).

The IVDMD of the genotypes at Isabela and Mayagüez ranged over CI from 50 to 40 percent (Fig. 4). Apparently, the optimum time to harvest these grasses both at Isabela and Mayagüez is 65 days, when the best compromise can be reached for IVDMD, CPC and DMY.

Plant height (PHt) of the four genotypes increased with cutting interval at the two locations but was superior at Mayagüez (Fig. 5). Previous studies (3) have shown that PHt is an important agronomic trait closely associated with yield.

These results indicate that Millo Blanco and the three IPFH of *Pennisetum glaucum* x *P. purpureum* are excellent forage sources, with DFY, CPC, and IVDMD values comparable or superior to the best tropical grasses. They also have several advantages over most of the other grasses: their ability to be propagated by seed and their high yields in a relatively short time.

The perennial nature of the IPFH plus their production of excellent quality forage attest to their potential as valuable new forage grasses for the tropics.
REFERENCES


Table 1 Analysis of variance for location, genotypes and cutting intervals of three *Pennisetum* interspecific forage hybrids and forage sorghum Millo Blanco in Puerto Rico.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>Dry matter content</th>
<th>Dry matter yield</th>
<th>Crude protein content</th>
<th>Crude protein yield</th>
<th>Plant height</th>
<th>In vitro dry matter digestibility</th>
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<td>Location (L)</td>
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<td>G X Cl</td>
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<td>8.1</td>
<td>655</td>
<td>2.0</td>
<td>47.5</td>
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</table>
Fig. 1 DRY MATTER YIELD

MAYAGUEZ

ISABELA

CUTTING INTERVAL (DAYS)

T / H α

0 5 10 15 20 25

45 65 85

IH101 IH102 IH103 MB
Fig. 2 CRUDE PROTEIN YIELD

![Graph showing crude protein yield for Mayaguez and Isabelia with different cutting intervals (days).]
Fig. 3 CRUDE PROTEIN CONTENT (%)
Fig. 4 IN VITRO DRY MATTER DIGESTIBILITY

[Graph showing the dry matter digestibility of grass cuttings at different cutting intervals for Mayaguez and Isabela, categorized by cutting intervals (45, 65, 85 days) and varieties (IH101, IH102, IH103, MB).]
Fig. 5 PLANT HEIGHT

![Bar chart showing plant height over cutting intervals for Mayaguez and Isabela, with cutting intervals in days and plant height measured in M.](image)