PROCEEDINGS

OF THE

33rd ANNUAL MEETING

6-12 July 1997

Proceedings Edited
by
Nelson Semidey and Lucas N. Aviles

Published by the Caribbean Food Crops Society
YIELD PERFORMANCE OF GUINEAGRASS HYBRIDS UNDER CUTTING MANAGEMENT

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ABSTRACT. Developing hybrids of guineagrass (Panicum maximum Jacq.) is difficult mainly because its reproduction is by apomixis. Utilizing sexual female plants and facultative apomictic genotypes, the following crosses were developed at the USDA-ARS, Tropical Agriculture Research Station (TARS): GH-101 (Tift SPM 92 x PI 3622); GH-102 (Tift 49 x CIAT 604); GH-103 (Tift 49 x PI 3622); and BPIH-104, a Brachiaria purpurascens x P. coloratum interspecific hybrid. In a randomized split-plot design with four replications, the four hybrids, common guineagrass, and cultivar Tobiata (a P. maximum introduction), were evaluated in terms of dry matter yield (DMY) and a series of agronomic characters at 4-, 6-, and 8-wk cutting intervals (CI) during the period of one year at the Isabela ARS farm. On the average, the genotypes DM production increased 60% from the 4- to 6-wk CI and 44% from the 6- to the 8-wk CI. Tobiata and GH-104 were the top yielders with over 38 and 39 t/ha/yr, respectively. These yields are significantly higher than those reported in the tropics for common guineagrass and comparable to yields produced by napiergrass (Pennisetum purpureum Schum.).

INTRODUCTION

Guineagrass (Panicum maximum Jacq.) reproduction is based on aposporous apomixis with pseudogamy, a condition which prevents sexual recombination and which might explain the absence of hybrids in the species. We reported for the first time, the existence of new Panicum hybrids including a cross of "malojillo" or paragrass (Brachiaria purpurascens Raddi) x kleingrass (Panicum coloratum L.) (Sotomayor-Rios et al., 1994). Three of the hybrids reported were developed utilizing sexual female plants crossed to apomictic lines.

Common guineagrass and many Panicum spp. introductions have been evaluated in Puerto Rico under cutting management (Vicente-Chandler., 1983; Vélez-Santiago et al., 1982, 1984; Sotomayor-Rios et al., 1971; Ramos-Santana and Rodriguez-Arroyo, 1991; Méndez-Cruz et al., 1988) although no detailed study has been made on these grasses as to their potential as parents for use in a breeding program.

Work conducted in the USDA, Mayaguez Federal Station (Warmke, 1951) showed that plants of five different strains of guineagrass differed significantly in size and in certain morphological characters and were given varietal designations. Common guineagrass, gramalote, broad-leaf and fine-leaf varieties were found to have 32 chromosomes while the somatic chromosome number of paragrass was found to be 36 based on root tip analyses. These findings by Warmke provided useful information which we utilized in the development of the guineagrass hybrids under study.

The objective of this study was to evaluate agronomically four guineagrass hybrids, common guinea and Tobiata (an introduction from Brazil), at three cutting intervals in northwestern Puerto Rico.
MATERIALS AND METHODS

The experiment was conducted at the USDA-ARS Isabela farm, 128 m elevation with ambient temperatures ranging from 18.5 to 29.4° C. The soil was an Oxisol (Typic Hapludox) with an organic matter content of 2.0% and pH of 5.9. The experimental design was a randomized complete block arranged in a split-plot with four replications. Genotypes (guineagrass hybrids GH101, GH102, GH103 and BPIH104, common guinea and Tobiata) were the main plots and three cutting intervals (4-, 6- and 8-wk) the subplots. The guineagrass hybrids were developed by the authors by crossing Tifton SPM92 x PI 259553 (GH101), Tifton 49 x CIAT 604 (GH-102), Tifton 49 x PI 259553 and paragrass x kleingrass (BPIH104). A description of the procedure utilized for the development and verification of the guineagrass hybrids was reported in a previous paper (Sotomayor- Rios et al., 1994).

Clumps of the six guineagrass genotypes, 7 cm in diameter, were planted in five rows 10.7 m long, spaced 50 cm within rows. Plots were fertilized at an annual rate of 3.5 t/ha divided into approximately 12, 8 and 6 applications. The center area of each subplot (3.5 x 2.28 m) was manually harvested at about 25-cm stubble to determine yield. Nitrogen content was analyzed by the micro-Kjeldahl procedure (AOAC,1980) and \textit{in vitro} dry matter digestibility (IVDMD) by a two-stage technique (Tilley and Terry, 1963). Data were analyzed as a mixed model using the mixed procedure in SAS version 6.11 for Windows (PC SAS) (SAS Institute, Inc., 1987).

RESULTS AND DISCUSSION

The mean annual dry matter yield (DMY) across genotypes was 33.6, 35.8 and 38.8 t/ha for the 4-, 6- and 8-wk cutting interval, respectively. Genotype differences were not significant at the 4-wk cutting interval except for GH102, which had significantly lower DMY than Tobiata. At the 6-wk cutting interval, Tobiata and BPIH104 were the top yielding genotypes with an annual DMY of 47.5 and 39.7 t/ha, respectively. BPIH104 and Tobiata were also the top yielding genotypes at the 8-wk cutting interval with an annual DMY of 42.9 and 41.3 t/ha, respectively (Fig. 1). Experiments conducted in Puerto Rico for various decades showed that about 26 and 32 t/ha of DMY are obtained on common guineagrass when harvested every 40 and 60 days with an annual application of 3 t/ha of a 15-5-10 fertilizer (Vicente-Chandler, 1983). In this study, common guinea yielded about 82.5 and 83.7% of the highest producer (Tobiata) at the 4- and 6-wk cutting intervals. At the 8-wk cutting interval, common guinea yielded about 83.4% of the highest producer (BPIH104).

The mean crude protein (CPC) concentration for genotypes at the 4-, 6-, and 8-week cutting interval was 12.5, 9.4 and 8.3%, respectively. The mean CPC at the 4-wk cutting interval was significantly higher than that of the two other intervals and the 6-wk mean CPC was significantly higher than that of the 8-wk cutting interval. At the 4-wk cutting interval, the CPC of GH102 (13.6%) was significantly higher than that of the remaining genotypes, except for that of GH103 (13.5%). At the 6-wk cutting interval, the mean CPC of GH102 (10.2%) was significantly higher than that of GH101 (8.6%) but similar to the remaining genotypes. Common guineagrass had the highest CPC at the 8-wk cutting interval (9.0%) although it was similar to the remaining genotypes except GH101 (Fig. 2).

The mean crude protein yield (CPY) for genotypes was 310, 392 and 495 kg/ha at the 4-,
6- and 8-wk cutting intervals respectively. At the 4-wk cutting interval no significant differences among genotypes were obtained. At the 6-wk cutting interval, the mean CPY of the genotypes was similar except that of Tobiata which was superior to that of GH101. At the 8-wk cutting interval the CPY of the genotypes was similar for most of them except that of GH1-101 and Tobiata which were significantly lower than that of BPIH104 and GH103 (Fig. 3).

The mean IVDMD across genotypes decreased significantly with the cutting interval. At the 4-wk cutting interval the mean IVDMD was 63.2% compared to 55.0% for the 6- and 8-wk cutting intervals. There were no significant differences among genotypes at each cutting interval (Fig. 4).

The mean plant height (PHt) for genotypes increased as the cutting interval increased. The mean PHt at the 4-, 6-, and 8-week cutting intervals was 73, 99 and 124 cm, respectively. The mean PHt at the 4-week cutting interval compares favorably with the results obtained at Corozal, Puerto Rico where 11 Panicums were evaluated every 30 days by Ramos-Santana and Rodriguez-Arroyo (1989) (Fig. 5).

CONCLUSIONS

Tobiata and BPIH104 produced the highest DMY at the 6- and 8-wk cutting intervals, significantly more than common guinea and some of the remaining hybrids and warrant further evaluation under grazing management in Puerto Rico. Hybrids GH101, GH102 and GH103 also had excellent yields and other useful traits which also deserve further evaluation under cutting and grazing management. More efforts should be made in finding germplasm having desirable traits such as non seed-shattering being able to produce high-quality forage for use in a breeding program utilizing the available sexual guineagrass genotypes as female plants.

REFERENCES


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Figure 1. Dry matter yield of four guineagrass hybrids, common guinea and cv Tobiata harvested at 4-, 6- and 8- week cutting intervals, Isabela, P.R., 1996.
Figure 2. Crude protein content of four guineagrass hybrids, common guinea and cv Tobiata planted at 4-, 6-, and 8-week cutting intervals, Isabela, P.R., 1996.

Figure 3. Crude protein yield of four guineagrass hybrids, common guinea and cv Tobiata harvested at 4-, 6-, and 8-week cutting intervals, Isabela, P.R., 1996.
Figure 4. Plant height of four guineagrass hybrids, common guinea and cv. Tobiata harvested at 4-, 6-, and 8-week cutting intervals, Isabela, P.R., 1996.

Figure 5. IVDMD of four guineagrass hybrids, common guinea and cv Tobiata harvested at 4-, 6-, and 8-week cutting intervals, Isabela, P.R., 1996.