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FORAGE POTENTIAL OF Stylosanthes guianensis IN PUERTO RICO

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ABSTRACT

This study was conducted to evaluate the yield potential of six Stylosanthes guianensis introductions planted monthly from February to July, 1989, under short- and long-day periods, and harvested at 60 and 120 days after an initial 180-day cutting. Across planting dates, CIAT 184 had the highest mean DFY and CPC (7,160 kg/ha and 9.7%, respectively) at the 180-day cutting. The highest DFY and CPC were those of the February planting. Across planting dates and at the 60-day cutting, CIAT 1283 had the highest DFY (2,194 kg/ha) while the CPC of the six Stylos remained relatively constant (12.2-13.0%). At the 120-day cutting, across planting dates, CIAT 184 had the highest DFY (5,064 kg/ha) with a mean CPC of 11.7%. A positive linear relation was observed between days to flower and DFY. Significant differences were obtained among Stylos for all planting dates in terms of IVDMD (60-day harvest) except June and July. Across planting dates, all Stylos were significantly superior to CIAT 15 and CIAT 136. Based on this preliminary study, the optimal time for planting Stylo in Puerto Rico appears to be February-March.

INTRODUCTION

In the tropics, forage legumes could play a more important role for milk and beef production. It appears that more information on the utilization of superior species is needed, an aspect which should be coupled with adequate incentives to farmers. Well fertilized forage grasses provide higher dry matter yields than forage legumes; however, the rising cost of fertilizers, especially in developing countries, often makes intensive animal production less competitive. Proper grass-legume combinations may provide lower, but more profitable yields.

Stylosanthes guianensis (Stylo) has a great potential as a forage crop, either alone or in combination with grasses in the humid and semi-humid tropics (Vélez-Santiago et al., 1981). According to Thomas and Grof (1986), a gain of 158 g/animal/day was reported in grazing trials in Brazil during the dry season in associations of Stylo and Andropogon gayanus var. planaltina. On the other hand, Paladines and Leal (1978), reported gains of 400-500 g/animal/day in association studies of Stylo and Melinis minutiflora conducted in Colombia.

Literature review of Stylosanthes carried out by CIAT (Centro Internacional de Agricultura Tropical), Cali, Colombia, covered research in the tropics from 1931 to 1985 (CIAT, 1987). This review listed 244 research activities conducted in North, Central and South America and the Caribbean. Most of the studies were on adaptation and preliminary agronomic evaluation. Brazil and Colombia were responsible for the most studies, 67 and 57, respectively. This amount represents 51% of all the publications listed.

The dry matter (DM) yield of introductions and cultivars of Stylo, evaluated alone, or in association with grasses, varied from 3.1 to 18.8 t/ha (Kretschmer et al., 1974; Velázquez and Bryan, 1975; Grof, 1981; Vélez-Santiago et al., 1981; Vélez-Santiago and Arroyo-Aguilú, 1984; Aragao et al., 1985; Monzote et al., 1985; CIAT, 1987; Arias et al., 1990).

The crude protein content (CPC) and in vitro dry matter digestibility (IVDMD) reported ranged from 16.5% - 19.0% and 60.4% - 61.20%, respectively (Vélez-Santiago et al., 1981); Vélez-Santiago and Arroyo-Aguilú, 1983; Monzote et al., 1985; CIAT, 1988; Arias et al., 1990).

This study was conducted to evaluate the forage yield potential of six Stylo introductions, planted monthly at Isabela, Puerto Rico, from February to July, 1989 under short- and long-day periods and harvested at 60 and 120 days after an initial 180-day cutting.

MATERIALS AND METHODS

The experiment was conducted at the Isabela experiment farm of the Tropical Agriculture Research Station (TARS), USDA, ARS, Mayagüez, Puerto Rico. The Isabela farm is approximately 18°N latitude and 67°W longitude. Daylength varied from 13.13-11.02 hours. Mean daily temperature varied from 18.5-29.4°C. The soil at the Isabela location is an Oxisol (Tropeptic haplorthox) Coto clay. Rainfall follows a common pattern for the tropics with a marked dry season from December to March and an overall monthly average of 1,675 mm. The six forage legume introductions evaluated, their accession number, origin and cultivar name are as follows:

Accession No.	Origin	Cultivar
CIAT 13	Mexico	Endeavour
CIAT 15	Bolivia	Graham
CIAT 184	Colombia	Pucallpa
CIAT 1280	Brazil	Pauciflora
CIAT 1283	Brazil	Pauciflora
CIAT 10136	Brazil	Pauciflora

Immediately before planting the seed was scarified in concentrated sulfuric acid for eight minutes and drained in running water for 12 minutes.

Plantings of the six accessions were made the 21st day of each month starting in February 1989 to July 1989. The experimental design was a split-plot in time arrangement of a randomized complete block with four replications. Genotypes were considered as whole plots and harvest dates were sub-plots. Plots were 5.0 x 2.25 m with rows spaced 0.75 m apart. For weed control, alachlor (Lasso) was applied at a rate of 1.5 l/ha immediately after planting. At planting, P_2O_5 was applied to all plots at a rate of 50 kg/ha as triple superphosphate. Plants were irrigated as needed during the first month after planting to prevent moisture stress. Plots were harvested with a side mower attached to a tractor at 60 and 120 days after an initial 180-day cutting. The cutting height was 0.25 m above ground level.

Dry forage yields were calculated for each cutting. Samples for CPC were analyzed at the Chemical Nutritional Laboratory of the University of Puerto Rico, Mayagüez Campus. Samples for the IVDMD were analyzed only for the 60-day cutting at the USDA-ARS, Georgia Coastal Plain Experiment Station, Tifton, Georgia.

Combined analyses of variance over planting dates were used. Least significant difference tests (0.05) were used to compare treatment means.

RESULTS AND DISCUSSION

Results from the combined analysis of variance for DFY and CPC showed significant differences among planting dates, accessions, and harvests for both traits (Table 1).

In Puerto Rico, the effect of photoperiodism on plants can be studied providing reliable results on flowering and growth habits. Figure 1 shows the relationship between daylength and month of the year with June 21 and December 21 being the longest and shortest days, respectively. Short-day plants such as sorghum, Sorghum bicolor L. Moench., and most tropical grass species will flower in Puerto Rico only during periods of 12 hours of light or less (Sotomayor-Rios et al., 1985). For instance, photoperiod sensitive sorghums require over 60 and in some instances 120 or 180 days to flower during the long days in Puerto Rico (Sotomayor-Rios et al., 1985). In the present study, the six Stylosanthes accessions on the average responded to planting dates and varied from 238 (February planting) to 113 days (July planting). Accession CIAT 15 was the earliest to flower as compared to the remaining Stylosanthes. When planted in February and July it took 105 and 70 days to flower, respectively (Table 2).

Table 1. F values for the combined analyses of dry matter yield and crude protein content of six Stylosanthes guianensis accessions across six planting dates and three harvests, Isabela, Puerto Rico, 1989.[1/]

Source of variation	DMY	CPC
Planting date (PD)	3.7**	46.9**
Replication (R)	1.2	2.1**
Accessions (A)	43.8**	4.4**
PD x A	1.3	1.9**
Error A	1.2	0.9
Harvest (H)	213.9**	112.6**
PD x H	56.8**	23.9**
A x H	17.8**	1.7
Error B	2.8**	2.2**
C.V. (%)	38.3	12.4

1/ Significant at the 0.01 probability level.

Table 2. Days to midbloom of six Stylosanthes guianensis accessions at six planting dates at Isabela, Puerto Rico, 1989.

Accession	February	March	April	May	June	July	Mean
	Days to midbloom						
1283	277	231	218	187	157	125	199
10136	274	247	216	187	156	125	201
136	264	235	206	174	143	113	189
1280	259	244	213	183	153	123	196
184	249	222	219	168	141	118	186
15	105	192	161	131	100	70	126
Mean	238	228	205	172	142	113	
LSD (.05)	23	19	29	3	6	2	

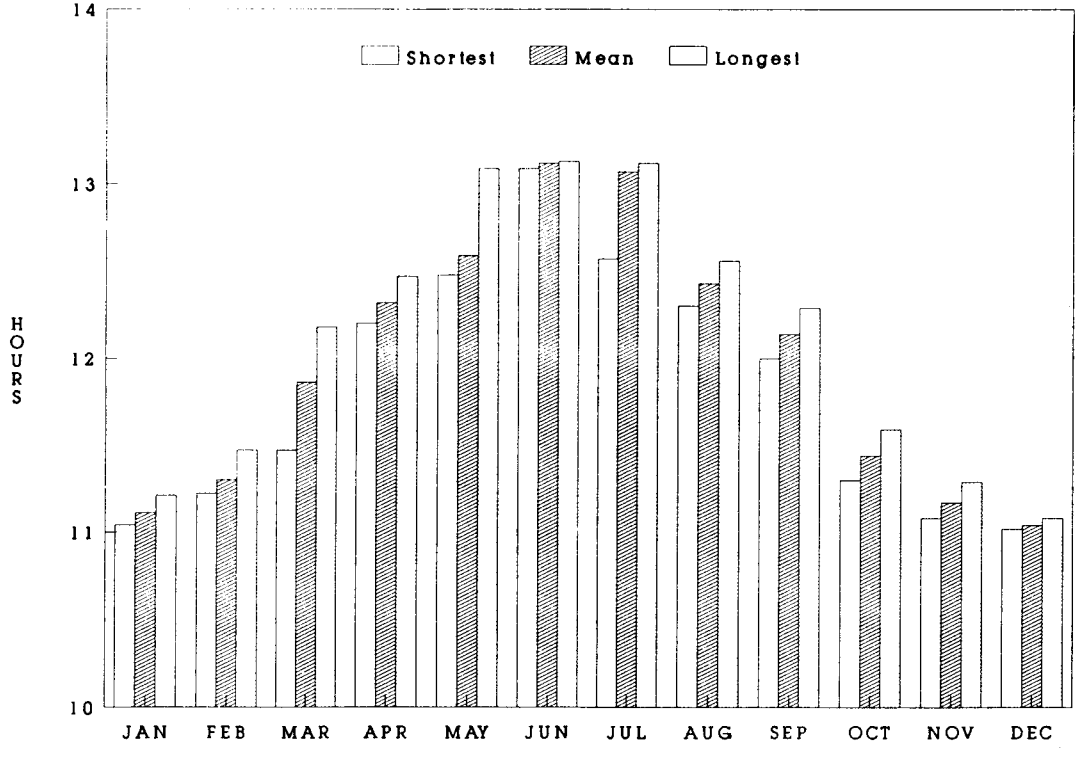

Fig. 1. Relationship between daylength and month on the year in Puerto Rico

The mean DFY of the six Stylosanthes accessions when harvested 180 days after planting ranged from 7,119 (February planting) to 2,113 kg/ha (July planting), respectively. The highest yielding accessions of the February planting was CIAT 184 (10,322 kg/ha) while the lowest was CIAT 10136 (1,825 kg/ha). Across planting dates, CIAT 184 had the highest DFY (7,160 kg/ha). The mean CPC of the six Stylosanthes accessions ranged from 13.5 (February planting) to 7.9% (April planting). Across planting dates the CPC ranged from 11.1 to 9.5%. CIAT 1283 CPC was significantly superior to CIAT 184 (Table 3).

The mean DFY of the six Stylosanthes at the 60-day harvest ranged from 2,505 (July planting) to 898 kg/ha (April planting) In the July planting CIAT 15 has the lowest yield (1,268 kg/ha). The CPC across planting dates for all accessions was 12.7%. In the February planting, CIAT 136 had the highest CPC (16.6%) while CIAT 15 was the lowest (14.5%) (Table 4).

The IVDMD was determined only for the 60-day harvest and ranged from 61.2 (May planting) to 49.2% (July planting) (Table 5). CIAT 10136 had the highest IVDMD with 56.5% across planting dates (Table 5).

At the 120-day harvest, the mean DFY of the six Stylosanthes increased 120% over the 60-day harvest. The DFY ranged from 6,006 (July planting) to 2,281 kg/ha (April planting). The highest DFY were obtained, on the average, during the July planting at the 60- and 120-day cuttings. In the July planting, CIAT 15 had the highest DFY (7,578 kg/ha) while CIAT 10136 was the lowest (2,435 kg/ha). The mean CPC across planting dates ranged from 12.9 (July planting) to 9.9% (March planting). CIAT 1283 had the highest crude protein content (13.9%) during the July planting (Table 6).

The data showed that most of the Stylosanthes accessions tested have excellent potentials as a forage legume crop in Puerto Rico. The DF yields in the 60- and 120-day cuttings are indicative of the potential value of these Stylosanthes accessions as a feed for livestock under an intensive management system.

Table 3. Mean dry forage yield and crude protein content of six Stylosanthes guianensis accessions at each of the six planting dates, harvested 180 days after planting, Isabela, Puerto Rico, 1989.

Accession	February	March	April	May	June	July	Mean	February	March	April	May	June	July	Mean
	kg/ha							(%)						
184	10322	6652	11223	6417	4244	4100	7160	12.4	9.2	6.5	11.1	9.8	9.1	9.7
15	9626	4603	8808	6290	6312	2508	6358	12.5	11.2	7.7	8.9	8.2	8.2	9.5
136	9137	4255	6580	2998	4726	3804	5750	13.2	10.7	7.6	11.0	9.0	9.3	10.1
1280	5649	4706	7082	5872	2514	996	4470	14.9	10.1	8.0	8.3	8.5	11.4	10.2
1283	3510	4070	5781	2679	2225	925	3198	14.1	12.0	9.2	11.2	10.3	10.0	11.1
10136	1825	1197	2529	918	140	346	1159	14.1	10.7	1.7	10.6	10.7	9.9	10.8
Mean	7119	4247	7000	4338	3500	2113	4599	13.5	10.6	7.9	10.2	9.3	9.7	10.2
LSD (.05)	4899	2182	3089	2540	2219	2380	1516	1.8	2.3	2.7	3.1	3.4	0.8	1.1

Table 4. Mean dry forage yield and crude protein content of six Stylosanthes guianensis accessions at six planting dates harvested 60 days after an initial cutting of 180 days, Isabela, Puerto Rico, 1989.

Accession	February	March	April	May	June	July	Mean	February	March	April	May	June	July	Mean
	kg/ha							%						
1280	3365	2163	553	1020	2578	2794	2079	15.7	14.0	10.6	12.2	12.5	13.1	13.0
1283	2432	2255	1098	2635	2127	2616	2194	16.5	15.0	11.3	10.5	11.2	13.4	13.0
15	2252	2228	727	1853	2353	3338	2125	14.5	12.8	12.3	7.8	13.9	12.1	12.2
136	1678	2403	1364	2143	1815	2840	2039	16.6	11.7	13.2	8.9	10.4	14.0	12.5
10136	1668	1380	1274	1420	1417	1268	1405	15.2	13.3	10.5	10.6	12.8	12.5	12.5
184	1335	1313	375	1465	2049	2137	1445	16.4	12.0	12.5	10.5	13.5	12.9	13.0
Mean	2141	2040	898	1756	2057	2505	1881	15.8	13.2	11.6	10.1	12.4	13.0	12.7
LSD (.05)	1239	1161	567	1097	811	1164	578	2.0	2.0	3.4	0.9	2.0	1.7	1.4

Table 6. Mean dry forage yield and crude protein content of six Stylosanthes guianensis accessions at six planting dates harvested 120 days after an initial cutting of 180 days, Isabela, Puerto Rico, 1989.

Accession	February	March	April	May	June	July	Mean	February	March	April	May	June	July	Mean
	kg/ha							%						
1283	5207	3920	3403	4313	4471	5172	4414	11.6	9.6	10.8	12.7	10.5	13.9	11.5
15	5202	3843	2351	3953	5088	7578	4669	12.2	10.4	10.1	12.8	10.1	11.6	11.2
1280	5151	2168	1655	2726	3971	5838	3585	11.4	11.0	9.5	12.2	11.0	13.2	11.4
136	4358	4248	2423	3295	5014	6686	4337	9.4	7.0	11.4	11.9	11.4	12.7	10.6
184	4135	3018	2002	3938	8965	8327	5064	11.6	10.2	11.9	13.2	10.7	12.7	11.7
10136	3626	2865	1850	1378	4610	2435	2794	10.9	11.5	11.7	11.4	11.2	13.2	11.7
Mean	4613	3343	2281	3267	5353	6006	4144	11.2	9.9	10.8	12.4	10.8	12.9	11.4
LSD (0.05)	1485	1327	1092	908	2495	1870	1330	1.7	0.7	2.0	1.5	2.2	2.4	1.1

Table 5. *In vitro* dry matter digestibility of six *Stylosanthes guianensis* at six planting dates harvested 60 days after an initial cutting of 180 days, Isabela, Puerto Rico, 1989.

Accession	February	March	April	May	June	July	Mean
	----------	----------	----------	%	----------	----------	----------
1280	55.7	53.0	58.3	58.4	58.7	50.0	55.7
1283	54.0	51.9	54.7	58.9	63.3	48.3	55.2
15	45.8	50.7	47.5	60.9	56.7	49.0	51.8
136	46.1	47.4	46.7	58.5	63.4	46.3	51.4
10136	51.2	51.0	60.9	66.8	57.3	51.6	56.5
184	49.1	45.9	56.3	63.7	58.3	50.3	53.9
Mean	50.3	50.0	54.0	61.2	59.6	49.2	54.1
LSD (.05)	4.0	3.9	3.8	4.2	7.1	4.3	2.2

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