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Dry matter yield of promising *Panicum maximum* genotypes in response to phosphorus and lime on Brazilian savanna

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Introduction

Soil fertility of the Brazilian savanna (Cerrado) is naturally poor. Extensive areas of pastures located in the central part of the territory are cultivated with *Brachiaria* grasses, which are less demanding for soil nutrients and lime than other species (Rao et al. 1998). On the other hand, *Panicum maximum* cultivars, such as the high yielding Mombaça grass recommended for intensive beef and dairy cattle systems (Euclides et al. 2008), must be seeded with a higher amount of fertilizer, especially phosphorus (P). Consequently, an effort is underway to select *P. maximum* genotypes with low P demand and high responsiveness. The objective of this study was to evaluate dry matter yields of genotypes of *P. maximum* in response to doses of P and lime in the Brazilian Cerrado.

Methods

The trial was conducted at Planaltina, Federal District, Brazil (15°35' S, 47°42' W; 1,007 m asl) from January 2012 to March 2013. Local annual rainfall averages 1,230 mm, concentrated between October and March. The soil of the area is classified as Oxisol with pH 4.2; P (Mehlich-I) 0.33 mg/dm^3; Ca 0.96 cmol$_c$/dm^3; Mg 0.54 cmol$_c$/dm^3; K 0.28 cmol$_c$/dm^3; base saturation 21%; and Al saturation 24%.

The promising *Panicum maximum* accessions PM32, PM34, PM39 and PM40 and cvv. Mombaça and Massai were evaluated with 3 rates of P (0, 25 and 175 kg/ha) and 2 levels of lime. The experimental design was completely randomized in a split-plot arrangement with 3 replications, with P allocated in the plots and genotypes in the subplots (2.5×3.5 m). The trial was replicated in 2 separate areas to evaluate 2 levels of dolomitic lime (1.6 and 3.2 t/ha), applied on 25 November 2011. Lime treatments were estimated to raise base saturation (BS) to 35% and 50%, respectively. Plots were fertilized with P (triple superphosphate) and seeded after tillage on 13 January 2012 in lines spaced 0.5 m apart.

Dry matter yield (DMY) was determined by cutting the forage at 20 cm from soil level. Harvests were done on 20 March 2012 (for 175 kg/ha P); 26 April 2012 (for 25 and 175 kg/ha P); and for all P levels on 11 July 2012; 03 December 2012; 30 January 2013; and 25 March 2013. On plots not harvested in March and April 2012, sward height did not exceed 20 cm. A total of 100 kg N and 83 kg K/ha were applied as 2 equal dressings on 20 March 2012 and 03 December 2012. DMY data were analyzed separately for the establishment (first 3 harvests) and maintenance (last 3 harvests) phases. Analysis of variance was performed using PROC GLM (SAS 1996) and comparison of genotype means using the Tukey test ($P<0.05$).

Results and Discussion

During the establishment period, DMY was affected by genotype and P for both lime rates ($P<0.05$; Table 1), with no significant interaction ($P>0.05$). No cultivar or accession produced viable yields in the absence of P fertilizer, as was also reported by Guedes et al. (2012). All accessions and cultivars responded well to P fertilizer at both BS levels. Cultivar Mombaça, PM32, PM34 and PM40 were the most productive genotypes during the establishment phase.

For the maintenance phase, there was a significant ($P<0.05$) genotype × P effect on DMY for BS 35% (Table 2). At all P levels, cv. Massai produced the highest yields but these were not always significantly greater than those of the other accessions. Obviously, cv. Massai has a low demand for P but responds well to P applica-

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tions. All accessions produced high yields at the highest P level (3,000–4,900 kg/ha). Only genotype ($P<0.05$) and P ($P<0.05$) effects were detected on DMY for BS 50%, which is the target usually recommended for *P. maximum*. During this phase, cv. Massai produced approximately 1,000 kg more forage than the other accessions.

Once established, all accessions produced useful DMYs in the absence of applied P, especially at BS 50% (Table 2). Although Mombaça, PM32, PM34 and PM40 were considered to be less P demanding than PM39 and cv. Massai in the establishment phase, all genotypes required P to achieve rapid regrowth. When pastures were established, all accessions required P to produce acceptable yields regardless of lime status. While PM39 was slow to establish, once established it produced high yields, as did PM32.

Table 1. Effects of P fertilizer level and base saturation (BS) on dry matter yields (kg/ha) of *P. maximum* genotypes during the establishment phase (first 3 harvests; January–July 2012).

P (kg/ha)	cv. Mombaça	PM32	PM34	PM39	PM40	cv. Massai	Mean
			BS 35% (1.6 t lime/ha)				
0	37	17	4	*	7	5	14C
25	2,575	2,306	2,258	1,025	1,694	765	1,919B
175	4,159	4,262	3,359	2,283	3,687	3,436	3,781A
Mean	2,257a[1]	2,195ab	1,874ab	-	1,796ab	1,402b	
CV = 7.3%							
			BS 50% (3.2 t lime/ha)				
0	312	83	60	23	133	40	109C
25	1,976	2,202	1,567	777	1,474	1,124	1,520B
175	4,050	3,469	3,120	2,696	3,685	3,072	3,349A
Mean	2,113a	1,918ab	1,582ab	1,165b	1,764ab	1,412b	
CV = 15.5%							

[1]Means followed by the same lower-case letter within rows and upper-case letter within columns did not differ by Tukey test ($P>0.05$). * No forage above 20 cm (not analyzed).

Table 2. Effects of P fertilizer level and base saturation (BS) on dry matter yields (kg/ha) of *P. maximum* genotypes during the maintenance phase of regrowth (last 3 harvests; July 2012–March 2013).

P (kg/ha)	cv. Mombaça	PM32	PM34	PM39	PM40	cv. Massai	Mean
			BS 35% (1.6 t lime/ha)				
0	826Bab[1]	597Bb	691Bb	218Bb	693Bb	1,805Ba	840
25	2,877Ab	3,384Aab	3,820Aab	3,426Aab	3,048Ab	4,382Aa	3,490
175	3,073Ac	4,233Aab	3,584Abc	4,074Aabc	3,554Abc	4,910Aa	3,905
Mean	2,259	2,738	2,699	2,867	2,432	3,699	
CV = 13.0%							
			BS 50% (3.2 t lime/ha)				
0	1,727	1,637	1,554	982	1,525	2,069	1,582C
25	2,507	3,413	3,316	3,379	2,990	4,494	3,350B
175	3,225	3,616	3,706	4,068	3,499	5,177	3,882A
Mean	2,486b	2,889b	2,859b	2,810b	2,671b	3,913a	
CV = 17.7%							

[1]Means followed by the same lower-case letter within rows and upper-case letter within columns did not differ by Tukey test ($P>0.05$).

Conclusion

All genotypes benefitted from P fertilizer during both the establishment and maintenance phases. They need adequate P to sustain high yields. Cultivar Massai could be considered both less demanding of and more responsive to P after the establishment phase.

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