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Adaptability and Stability of Productive Characteristics on the Selection of Pennisetum purpureum Schum. Clones Grazed by Sheep

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Adaptability and stability of productive characteristics on the selection of *Pennisetum purpureum* Schum. clones grazed by sheep

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Introduction

Elephant grass (*Pennisetum purpureum* Schum.) is one of the most widely used forages in Brazil, due to its high potential productivity, forage quality, palatability, vigour and persistence. Dwarf types of elephant grass are the object of selection programs for their higher leaf/stem ratio and lower grazing height, resulting in more efficient pasture management. They have high potential for ruminant production (Almeida *et al.* 2000), but have markedly different morphological and productive characteristics (Cunha *et al.* 2011) to tall varieties of the same species.

Adaptability and stability analyses are selection tools which allow identification of plant responses to different environments (Cruz and Regazzi 2001) and can identify stable productive clones across a range of environments. This study evaluated the genotype x environment interaction for productive characteristics of *P. purpureum* clones grazed by sheep.

Methods

The experiment was conducted at the Agricultural Research Station of the Agronomic Institute of Pernambuco (IPA), located at Itambé (07º25'S, 35º06'W) in the coastal region of Pernambuco, Brazil. Eight *Pennisetum* sp. genotypes were evaluated: (1) 5 dwarf types (Taiwan 227, Taiwan 237, Taiwan 2114, Merker México 6.31 and Mott); (2) 2 tall types (IRI 381 and Elephant B); and (3) one inter-specific hybrid (HV 241) of elephant grass and pearl millet (*P. americanum*). A randomized block design was used, with 4 replications. Clones were planted 1 m apart into furrows.

Clones were rotationally grazed by sheep. Pasture evaluation occurred from September 2008 to September 2010, totalling 10 grazing cycles. Grazing periods were 3 days, with resting periods between grazing of 32 days. Stocking rate was adjusted to give a residual stubble height of 0.3 m at the end of each grazing period. Mean herbage accumulation (HA) and herbage accumulation rate (HAR) of each plot were obtained by measuring green herbage mass (GHM) of forage in a 0.5 m^2 quadrat (0.5 m x 1.0 m) cut to 5 cm from ground level. Animal performance was not measured.

Adaptability (mean, β0 and linear regression coefficient, β1) and stability parameters (sum of the regression of absolute deviations, $\sigma^2 d_i$) were estimated for HA and HAR, using procedures described by Eberhart and Russell (1966) with the 'Genes' software (Cruz 2006). According to this methodology, adaptability is defined as the ability of genotypes to advantageously harness environmental stimuli, while stability is defined as the ability of genotypes to show highly predictable behaviour as a function of environmental stimuli.

Results

Mean herbage accumulation across all grazing periods ranged from 2180 kg DM/ha (Taiwan 237) to 3383 kg DM/ha (Mott), averaging 2796 kg DM/ha. Clones Mott and Taiwan 2114 had significantly higher HA (P<0.05) than clone Taiwan 237, but were not different from the others (Table 1). Dwarf clones, Mott (3383 kg DM/ha) and Taiwan 2114 (3212 kg DM/ha), and the tall type, Elephant B (3084 kg DM/ha), showed general adaptability and high predictability, with means greater than the general average (2786 kg DM/ha). These 3 clones will, therefore, be likely to increase their forage yield more efficiently to improved environments (temperature,

Table 1. Mean estimates of herbage accumulation (HA) and parameters β1i, $\sigma^2 d_i$ and r^2 in *Pennisetum* sp. clones across 10 grazing cycles

Genotypes	HA (kg DM/ha)	β1i	$\sigma^2 d_i$	r^2
Taiwan 227	2467 ab	0.7 ns	193651 *	61.4
Taiwan 237	2180 b	1.1 ns	54907 ns	87.4
Taiwan 2114	3212 a	0.8 ns	490254 **	55.3
Merker México 6.31	2575 ab	0.8 ns	20383 ns	81.5
Mott	3383 a	0.6 ns	780217 **	62.7
HV 241	2792 ab	1.5 *	166079 *	89.1
Elephant B	3084 ab	1.3 ns	375193 **	81.0
IRI 381	2669 ab	0.9 ns	251737 *	70.4
Average	2796	-	-	-

Means followed by the same letter do not differ in the Tukey test at 5% probability. * (P<0.05); ** (P<0.01); ns = non-significant at 5% probability, according to t tests.

Table 2. Mean estimates of herbage accumulation rate (HAR) and parameters β1i, σ²dᵢ e r^2 in *Pennisetum* sp. clones across 10 grazing cycles

Genotypes	HAR (kg DM/ha/d)	β1i	$\sigma^2 d_i$	r^2
Taiwan 227	60.8 bc	0.82 ns	-17543111 ns	66.6
Taiwan 237	51.4 c	0.72 ns	-17543226 ns	71.7
Taiwan 2114	79.7 ab	1.11 ns	-17542951 ns	70.0
Mercker México 6.31	64.0 bc	0.90 ns	-17543241 ns	82.7
Mott	87.7 a	1.27 ns	-17542558 ns	62.0
HV 241	67.4 abc	1.03 ns	-17543068 ns	73.2
Elephant B	75.9 ab	1.16 ns	-17543180 ns	83.8
IRI 381	64.9 abc	0.89 ns	-17543074 ns	67.6
Average	69.0	-	-	-

Means followed by the same letter do not differ in the Tukey test at 5% probability. ns: non-significant at 5% probability.

light or precipitation). Thus, they adapt to climatic or temporal variation at a given site over time. Except for clone HV 241, which had specific adaptation to favourable environments, the other clones demon-strated wide adaptability, considering that β1i was not significant by the t test (*i.e.* β1i = 1). Clone Mott had a higher HAR (P<0.05) than Taiwan 227, Taiwan 237 and Merker MX 631, but was not different from the other clones (Table 2). Mott (87.7 kg DM/ha/d) had the greatest HAR, followed by Taiwan 2114 (79.7 kg DM/ha/d) and Elephant B (75.9 kg DM/ha/d). These results indicate greater general adaptability and higher predictability of these 3 clones. They showed high and stable yields in unfavourable environments and an ability to respond positively in improved environments, regardless of seasonal variation.

Conclusion

Clones Mott, Taiwan 2114, and Elephant B presented greater adaptability and stability for herbage accumulation. Therefore, they are recommended for the next phase of evaluation in the elephant grass breeding program, in order to measure animal performance.

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