Performance and Correlation for Leaf Dry Matter Yield of Diverse Germplasm of *Panicum maximum* Jacq. under Two Levels of Soil Fertility in the Brazilian Cerrado

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Beef Cattle on Brazilian Cerrado

- Area: 205 million ha
- 50 million ha - cultivated grasslands with more than 50% of beef cattle herd
- Weathered Tropical Soils – Oxisols, Ultisols and Entisols
- Extensive systems are predominant, but things are changing!!!
  - Integrated and intensive systems!
Panicum maximum on Brazilian Cerrado

- Tropical apomictic autotetraploid (x = 8) perennial forage grass - 16% of the seed market

- High animal production - 1.200 kg of liveweight gain.ha^-1.y^-1

- High demanding in technology - Lime, fertilizers, rotational stocking, farm management
## Cerrado Soil vs *Panicum maximum* nutrition

<table>
<thead>
<tr>
<th>Soil/Plant</th>
<th>( \text{pH (H}_2\text{O)} )</th>
<th>Ca+Mg ( \text{cmol}_c.\text{dm}^{-3} )</th>
<th>K ( \text{cmol}_c.\text{dm}^{-3} )</th>
<th>P ( \text{mg.dm}^{-3} )</th>
<th>% Base saturation</th>
<th>% Al saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerrado</td>
<td>4.5-5.2</td>
<td>0.2-0.7</td>
<td>0.02-0.4</td>
<td>0.5-3.4</td>
<td>5.9-43.9</td>
<td>16.4-85.9</td>
</tr>
<tr>
<td>Panicum</td>
<td>&gt;5.5</td>
<td>&gt;2.0</td>
<td>&gt;0.13</td>
<td>&gt;4</td>
<td>&gt;45</td>
<td>&lt;20</td>
</tr>
</tbody>
</table>

- High input of fertilizers: lime, gypsum, potassium chloride, superphosphate
- Is there genotypes more efficient in using nutrients, i.e, lower losses with less nutrients?
- It would be desirable to reduce expending in fertilizers and to increase the profits of cattlemen

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*Martha Jr. et al. (2007) – Cerrado: uso eficiente de corretivos e fertilizantes em pastagens*
Objectives

- To estimate the losses of a low fertility soil on the performance of *P. maximum*;

- To calculate the correlation between a low and a high fertility soil for diverse cultivars and breeding material.
Material and Methods

- **24 Genotypes** (six cultivars, eight accessions and ten sexual plants)

Fig. 4 Association among 396 Panicum maximum accessions revealed using principal components analysis (PCA) based on Jaccard’s similarity coefficient calculated from 30 microsatellite loci. Samples are color-coded based on the STRUCTURE results.
Material and Methods

- Soil – Haplic Ferrallsoil – Clay soil – 55% of Clay – Campo Grande, MS, Brazil
- Use of lime, gypsum, superphosphate (18%) and potassium chloride to generate two levels of fertility

Goal!!!
- High Fertility Soil - 6 ppm of P<sub>2</sub>O<sub>5</sub> and 45% of base saturation (Ca+Mg+K)
- Low Fertility Soil – 2 ppm of P<sub>2</sub>O<sub>5</sub> and 35% of base saturation
Levels of Soil Fertility
Evaluations

- Design: RCB – three replicates
- Plots: 4.5 m²
- Trait: Leaf dry matter yield (kg.ha⁻¹.y⁻¹)
- Seven harvests from March 2017 to February 2018
- Nitrogen fertilization after each harvest in the rainy season - 150 kg N.ha⁻¹.y⁻¹
- Variance components based on REML and BLUPs for genotypes (Resende, 2016)
Heritability, accuracy and Mean BLUP (kg.ha$^{-1}$.y$^{-1}$)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LRT Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heritability</td>
<td>0.91**</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.95</td>
</tr>
<tr>
<td>Range</td>
<td>10,210 - 16,662</td>
</tr>
</tbody>
</table>
Economic losses for a system of growing and finishing phases

Forage yield and liveweight gain in kg.ha⁻¹

<table>
<thead>
<tr>
<th>Soil</th>
<th>Forage yield.y⁻¹</th>
<th>Forage yield.d⁻¹</th>
<th>aForage Availability .d⁻¹</th>
<th>bStocking rate</th>
<th>cLiveweight gain.d⁻¹</th>
<th>Liveweight gain.y⁻¹</th>
<th>Profit in US$.y⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFS (1)</td>
<td>16,275</td>
<td>44.59</td>
<td>22.30</td>
<td>3.38</td>
<td>2.03</td>
<td>740.95</td>
<td>889.14</td>
</tr>
<tr>
<td>LFS (2)</td>
<td>10,263</td>
<td>28.12</td>
<td>14.06</td>
<td>2.13</td>
<td>1.28</td>
<td>467.20</td>
<td>560.64</td>
</tr>
<tr>
<td>2 - 1</td>
<td>-6,012</td>
<td>-16.47</td>
<td>-8.24</td>
<td>-1.25</td>
<td>-0.75</td>
<td>-273.75</td>
<td>-328.50</td>
</tr>
</tbody>
</table>

Parameters: aForage availability=50%; bAnimal of 330 kg with 2% of LDMY consumption; cAverage daily liveweight gain=0.6.kg⁻¹; dUS$ 1.2.kg⁻¹.

Average losses: -37%
Genotype by Soil Interaction
Genotype by Soil Interaction

$r_{GxSoil} = 0.91$
Concluding Remarks

- Low soil fertility caused high mean losses in *P. maximum*
- There were no cultivars or breeding material more tolerant to lower soil fertility
- **The use of genetic tolerance is a challenge**
- Research in other areas should be encouraged
  - Example: Use of microrganisms?
  - *Tropical Grasslands* (2006), 40, 94–101
Thanks!

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Collaborator: