Brachiaria hybrids: potential, forage use and seed yield

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Abstract. A brachiaria breeding program initiated in 1988 at CIAT (Centro Internacional de Agricultura Tropical) combined desirable attributes found in accessions of Brachiaria brizantha and B. decumbens. Three apomictic hybrids have been released (cvs. Mulato, Mulato II and Cayman). Mulato showed agronomic potential but seed yields were low. Trials in Central America demonstrated the superiority of Mulato II, a vigorous grass with very deep and branched roots, giving it excellent drought resistance in the Brazilian Cerrado and Mexico. Mulato II has excellent nutritional value. Following trials in Mexico and Thailand, evaluating 155 new hybrids for 7 years, cv. Cayman was released due to strong waterlogging tolerance. Research conducted on growth, quality, production, persistence and seed yields of brachiaria hybrids in Asia, Central America and Africa from 2003 to 2013 is summarized in the paper.

Keywords: Brachiaria, forage quality, seed production, forage regrowth.

Introduction

The registration of Mulato hybrid brachiaria (Brachiaria ruziensis x B. brizantha) by Grupo Papalotla in 2004 (Miles et al. 2004) and the granting of Plant Variety Rights in 2002, marked a significant breakthrough for tropical perennial forage cultivars. Up until 2001, Brachiaria spp. cultivars used commercially were derived without genetic modification directly from natural collected germplasm from Africa or selected from germplasm collections in Australia and in tropical America. The development in Belgium of a tetraploidized sexual ruzigrass (B. ruziensis) (Swenne et al. 1981) and with further studies by Ndikumana (1985) and Valle et al. (1994), led to Dr Cacilda B. do Valle of Embrapa (Centro da Empresa Brasileira de Pesquisa Agropecuária) providing tetraploid, sexual ruzigrass to CIAT in 1988. The breeding program at CIAT, led by Dr John W. Miles, combined desirable attributes found in accessions of B. brizantha and B. decumbens.

In 2001, Grupo Papalotla was granted the exclusive rights worldwide, to produce, research, and commercialize the first generation of Brachiaria hybrids developed by CIAT from 2001-2010, under a contract of exclusivity signed with the Mexican seed company Grupo Papalota. Mulato showed considerable agronomic potential but seed yields were low (Hare et al. 2007a). Trials in Central America then demonstrated the superiority of Mulato II, a vigorous grass with very deep and branched roots, giving it excellent drought resistance in the Brazilian Cerrado and Mexico. Mulato II seed yields in Thailand were between 60 and 100% more than the highest seed yields of Mulato (Hare et al. 2007b; 2007c). From 2003-2008, further detailed studies were conducted in Mexico and Thailand on 155 new brachiaria hybrid lines resulting in four lines, CIAT BRO2/1718, BRO2/1752, BRO2/1794 and CIAT BRO2/0465 being granted Plant Variety Rights. CIAT BRO2/1752 produced similar dry matter yields to Mulato II, but in trials in Mexico demonstrated good water logging tolerance.

This paper will summarize the considerable research conducted on growth, quality, production, persistence and seed yields of brachiaria hybrids in Asia, Central America and Africa from 2003 to 2013.

Regional evaluations and research

Asia

Field studies at Ubon Ratchathani University, Thailand (15°N), between 2003 and 2007, showed that Toledo palisade grass (Brachiaria brizantha), Mulato and Mulato II produced more total dry matter and leaf dry matter, particularly during the dry season than other brachiaria grasses (Hare et al. 2009). Mulato II also produced significantly more leaf than the other brachiaria grasses in the studies (Hare et al. 2009). It has been the production of green leaves by Mulato II that has made it extremely attractive forage for livestock (Mutimura and Everson 2012).

From 2005 to 2008, 15 hybrid brachiaria lines were evaluated at Ubon Ratchathani University for dry production and quality and seed production (Table 1). Only two lines, BRO2/0465 in the wet season in Trial 1 and BRO2/1752 in the wet season in Trial 2, produced more dry matter (DM) than Mulato II. BRO2/0768 was the only
line that produced a higher percentage leaf DM than Mulato II, in the wet season of Trial 1 and in the dry season of Trial 2 (Table 1). BRO2/1794 produced significantly more seed than Mulato II, significantly more seed than all the BRO6 lines. In this trial, BRO2/1794 produced less seed than Mulato II, in the wet season of Trial 1 and in the dry season of Trial 2 (Table 1). BRO2/1794 produced significantly more seed than Mulato II, in the wet season of Trial 1 and in the dry season of Trial 2 (Table 1). BRO2/1794 produced significantly more seed than Mulato II, in the wet season of Trial 1 and in the dry season of Trial 2 (Table 1).

From 2008 to 2011, a further 28 hybrid brachiaria BRO6 lines were evaluated alongside Mulato II, Marandu, Toledo and promising BRO2 lines, 1794, 0465, 1718 and 1372. None of the BRO6 lines produced significantly more dry matter than Mulato II. Mulato II produced significantly higher percentage of leaf DM than all the other lines in both the wet season and dry season, except for BRO6/1922 in the dry season. Mulato II and BRO2/1718 produced significantly more seed than all the BRO6 lines. In this trial, BRO2/1794 produced less seed than Mulato II, BRO2/1718 and BRO2/0465.

Field trials conducted by the Thailand Department of Livestock Development (DLD) from 2004 to 2006 in northern Thailand (18°N, 319 m a.s.l.), showed that Mulato and Mulato II produced significantly higher DM yields than ruzi grass, but ruzi grass produced 3-4 times the seed yields of Mulato and Mulato II (Phumphiat et al. 2007). In the dry season, Mulato and Mulato II produced 60% more DM than ruzi grass. In seed production trials conducted by DLD from 2007 to 2010 on hybrid brachiaria lines BRO5, MXO2 and BRO4. Over four years, only one new line, MXO2/2552, produced more seed than Mulato II and this was due to the high seed yield in 2010. In 2009, seed yields were low overall, due to dry conditions during anthesis and seed set. Further trials from 2008 to 2010 at the same location found that none of the BRO6 lines produced significantly more seed than Mulato II.

In Mexico, evaluations on the hybrid brachiaria collections commenced in 2005 at Santa Elena, Oaxaca (16°N, (4-8 m a.s.l. 800-1200 mm annual rainfall, 6-8 months dry season) on very sandy soils, with low organic matter, low N and low P and a pH of 5.6. To date, studies have been conducted on 15 BRO2 lines, 38 BRO5 lines, 28 BRO6 lines and 74 BRO9 lines.

Further trials conducted in Thailand by DLD showed that digestible dry matter of Mulato II and three hybrid brachiaria lines was excellent. Leaf digestible dry matter averaged 75% and stem digestible dry matter averaged 60%.

Table 1. Average wet season (May-October) and dry season (November-April) dry matter yields and leaf percentage of hybrid brachiaria lines from 2006 to 2008 in Ubon Ratchathani, Thailand.

<table>
<thead>
<tr>
<th>Hybrid brachiaria</th>
<th>Dry matter yields</th>
<th>Leaf percentage</th>
<th>Pure seed yields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wet</td>
<td>Dry</td>
<td>Wet</td>
</tr>
<tr>
<td>Mulato II</td>
<td>8674</td>
<td>2886</td>
<td>10566</td>
</tr>
<tr>
<td>Cayman</td>
<td>9252</td>
<td>2837</td>
<td>12597</td>
</tr>
<tr>
<td>BRO2/0465</td>
<td>11477</td>
<td>3050</td>
<td>11594</td>
</tr>
<tr>
<td>BRO2/1794</td>
<td>9420</td>
<td>2655</td>
<td>11149</td>
</tr>
<tr>
<td>BRO2/1718</td>
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<td>2517</td>
<td>10394</td>
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<td>BRO2/0768</td>
<td>8542</td>
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<tr>
<td>BRO2/1452</td>
<td>8901</td>
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<tr>
<td>MXO2/1423</td>
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<td>2343</td>
<td>7667</td>
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<tr>
<td>MXO2/1263</td>
<td>10853</td>
<td>3178</td>
<td>10859</td>
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<tr>
<td>LSD (P=0.05)</td>
<td>2660</td>
<td>751</td>
<td>1349</td>
</tr>
</tbody>
</table>

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days after cutting, Mulato II produced 30 tonnes, Cayman 21 tonnes and BRO2/0465 18 tonnes of DM/ha. Hay was made from the 120 day-old forage and the regrowth after 30 days found that Cayman and BRO2/0465 produced significantly more dry matter (700-740 kg/ha DM) than Mulato II (100 kg/ha DM).

In the USA, studies at the University of Florida, Beef Research Unit (29°N; 45 m a.s.l.) from 2010 to 2011, have been conducted on forage production, nutritive value and persistence of Mulato II and Cayman under grazing conditions (Lynn Sollenberger, Andre Soares, Joao Vendramini pers. comm.). Under intensive grazing every two weeks, both hybrids had significantly higher percentage of leaf (70-80%), crude protein (19-21% in leaves, 10-12% in stems) and IVDOM (73-75% leaf, 59-61% stem) than grazing every 4 and 6 weeks, similar to the high quality achieved under cutting in Thailand.

Africa

Improved hybrid brachiaria grasses were evaluated in Rwanda (2°S) at a lower rainfall site (1400 mm/year) and a higher rainfall site (1800 mm/year) that had high Al levels (47 meg/100g of soil), against an indigenous signal grass (B. decumbens) and a naturalized buffel grass (Cenchrus ciliaris). At the low rainfall site, the improved brachiaria cultivars, BRO2/1485 and the local B. decumbens accession produced more dry matter than buffel grass and Brachiaria hybrids BRO2/0465 and BRO2/1452. Farmers were asked to rank the grasses and they selected Mulato II as the preferred cultivar at both sites, because of its production of green forage all year round without any input of fertilizer, high above ground biomass production, palatability, drought tolerance, quick regrowth, persistence, being a perennial, and being easy to cut and carry (Mutimura and Everson 2012).

Commercial pasture development

In Vietnam, Mulato II is used as cut-and-carry forage for dairy farmers because of its high protein levels, high palatability and high digestibility (Raf Somers pers. comm.). In Thailand, Laos and Malaysia, expansion of Mulato II has been slow, due to the strong competition from far cheaper ruzi grass seed produced in Thailand.

In the Pacific region, over 10,000 hectares of Mulato II pastures have been established in Vanuatu since 2007 where it is primarily used for beef cattle grazing. In Africa, Mulato II pastures have been established on nearly 1000 smallholder farms in Kenya, Tanzania and Ethiopia and on larger farms in Congo and Uganda. In Rwanda, 50 hectares of Mulato II have been planted to provide planting material for farmers to plant vegetatively. In Burundi, Mulato II is currently being evaluated on research stations.

In the Americas, nearly 200,000 ha of Mulato II pastures have been established since 2005 for both dairy and beef cattle grazing.

Commercial seed production

Mulato II and Cayman seed production in Thailand and Laos is harvested by hand. In Thailand, the seed is ground-swept and in Laos the seed is harvested by knocking the seed from seedheads. The seed is hand cleaned by the farmers and then acid scarifird in Thailand to reach 98% purity, 90% seed viability and 80% seed germination.

In Central and South America, seed is only produced in Mexico (Mulato II and Cayman) and Brazil (Mulato II). All the seeds are ground-swept using machinery (Pizarro et al. 2010). The seeds are cleaned and acid-scarified at a central locality in each country.

Conclusion

Since 2003, considerable amounts of research have been conducted on 155 hybrid brachiaria lines in Central and South America and in Asia, and only one new named cultivar released, Cayman in 2011. The outstanding waterlogging tolerance of Cayman has added a new dimension to the hybrid brachiaria collection. Research is continuing to evaluate the new BRO9 collection to select lines with high seed yields and high forage quality, that either display characteristics of persistence and tolerance to grazing, or have outstanding drought tolerance, or are upright with high dry matter yields for cut-and-carry forage systems, or display good shade tolerance.

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References


Pizarro EA, Hare M, Antezana Rojas JH, Ramon RR, Miranda IG, Chavez Chena A, Balbuena A, Miles J (2010). Harvest methods and seed yield potential in Brachiaria hybrids. In: Proceedings of the Seventh International Herbage Seed Conference (Eds GR Smith, GW Evers, LR Nelson) Dallas,


