# Botanical and agronomic growth of two *Panicum maximum* cultivars, Mombasa and Tanzania, at varying sowing rates

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## Abstract

A field trial in northeast Thailand during 2011–2013 compared the establishment and growth of 2 *Panicum maximum* cultivars, Mombasa and Tanzania, sown at seeding rates of 2, 4, 6, 8, 10 and 12 kg/ha. In the first 3 months of establishment, higher sowing rates produced significantly more DM than sowing at 2 kg/ha, but thereafter there were no significant differences in total DM production between sowing rates of 2–12 kg/ha. Lower sowing rates produced fewer tillers/$m^2$ than higher sowing rates but these fewer tillers were significantly heavier than the more numerous smaller tillers produced by higher sowing rates. Mombasa produced 23% more DM than Tanzania in successive wet seasons (7,060 vs. 5,712 kg DM/ha from 16 June to 1 November 2011; and 16,433 vs. 13,350 kg DM/ha from 25 April to 24 October 2012). Both cultivars produced similar DM yields in the dry seasons (November–April), averaging 2,000 kg DM/ha in the first dry season and 1,750 kg DM/ha in the second dry season. Mombasa produced taller tillers (104 vs. 82 cm), longer leaves (60 vs. 47 cm), wider leaves (2 vs. 1.8 cm) and heavier tillers (1 vs. 0.7 g) than Tanzania but fewer tillers/$m^2$ (260 vs. 304). If farmers improve soil preparation and place more emphasis on sowing techniques, there is potential to dramatically reduce seed costs.

## Resumen

Entre 2011 y 2013 se evaluaron en el noreste de Tailandia el establecimiento y el desarrollo de los cultivares (cvs.) Mombasa y Tanzania de *Panicum maximum* en densidades de siembra variables desde 2 hasta 12 kg/ha de semilla comercial, con incrementos de 2 kg/ha. En los primeros 3 meses del establecimiento, mayores densidades de siembra produjeron significativamente más materia seca (MS) que la siembra a 2 kg/ha, pero a partir de entonces no hubo diferencias significativas en la producción total de MS entre las tasas de siembra de 2−12 kg/ha. Densidades de siembra más bajas produjeron menos brotes/$m^2$ que tasas de siembra más altas, pero estos pocos brotes fueron significativamente más pesados que los brotes más numerosos pero más pequeños que se produjeron al incrementarse las tasas de siembra. El cv. Mombasa produjo 23% más MS que el cv. Tanzania en dos épocas lluviosas sucesivas: 7 vs. 5.7 t/ha entre junio 16 y noviembre 1 de 2011, y 16.4 vs. 13.4 t/ha entre abril 25 y octubre 24 de 2012. Ambos cultivares presentaron producciones similares de MS en las épocas secas (noviembre−abril), con promedios de 2 t/ha en 2011 y 1.75 t/ha en 2012. El cv. Mombasa produjo plantas más altas (104 vs. 82 cm), hojas más largas (60 vs. 47 cm) y más anchas (2 vs. 1.8 cm) y brotes más pesados (1 vs. 0.7 g) que Tanzania; sin embargo el número de brotes/$m^2$ (260) fue más bajo en Mombasa que en Tanzania (304). Se concluye que al mejorar los productores la preparación del suelo y poner más énfasis en técnicas de siembra, existiría el potencial de reducir drásticamente los costos de la semilla.

## Introduction

Tanzania guinea grass [*Panicum maximum* cv. Tanzania (cv. Si Muang in Thailand)] has been grown in Thailand for over 20 years (Phaikaew et al. 2007). In Thailand, it is considered to be a high quality cut-and-carry grass for dairy and beef cattle (Nakamanee et al. 2008) and not a grazed pasture grass, unlike in Brazil, where it is widely used for grazing (Santos et al. 2006). Mombasa guinea grass (*P. maximum* cv. Mombasa) was introduced to Thailand in 2007 (Hare et al. 2013a) from Brazil, where it produces high amounts of good quality herbage under grazing (Carnevalli et al. 2006). The main purpose of this introduction was to produce seed for export to Central America (Hare et al. 2013a; 2013b). However, there

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is now a rapidly growing market for Mombasa seed within Thailand and other countries in Asia, because of its reputedly greater dry matter (DM) production than that of Tanzania (Cook et al. 2005; Hare et al. 2013a).

Data from Brazil in separate trials showed that Mombasa (Silveira et al. 2010) was larger and taller than Tanzania (Santos et al. 2006) but there were no detailed data with both cultivars grown together in the same trial. There were also no comparative data of these cultivars growing in Thailand in trials at the same site.

Two studies have been undertaken at Ubon Ratchathani University, Thailand, to study these 2 cultivars, both botanically and agronomically. In the first study under cutting, Mombasa produced 17–21% more total DM and 18–24% more leaf DM than Tanzania (Hare et al. 2013a). This paper, which examines the effects of varying sowing rates, relates to the second study.

Guinea grasses are normally sown in Thailand at what might be considered a high rate of 12 kg seed/ha. The one thousand seed weights for Mombasa and Tanzania are, respectively, 1.51 and 1.16 g (Hare et al. 2013b). Sowing these seeds at 12 kg/ha with 70% germination results in approximately 555 potential seedlings/m$^2$ for Mombasa and 724 potential seedlings/m$^2$ for Tanzania. We have observed that sowing of guinea grass at 12 kg/ha produced a vast number of small plants, which competed strongly with one another. Survival of individual plants appeared lower than that of plants sown at a spacing of 50 cm x 50 cm (Nakamanee et al. 2008).

Our hypothesis was that pastures sown at a low sowing rate, while initially producing less DM than those sown at high sowing rates, would quickly compensate and tiller out strongly and, over time, these pastures would produce more DM than pastures from the high sowing rate.

## Materials and Methods

This study was conducted at a single site at the Amnart Charoen Livestock Development Centre, Amnart Charoen province, northeast Thailand (15.5° N, 104.4° E; elevation 130 masl) during 2011–2013. The site was on an upland sandy reddish brown earth (Haplustalf) soil (Chatturat series) (Mitsuchi et al. 1986). Soil samples taken at sowing in June 2011 showed that the soil was acid (pH 4.8; water method), very sandy (75% sand), and low in organic matter (0.6%), N (0.03%) and K (42 ppm), but average for P (24.3 ppm; Bray II extraction method). Prior to cultivation, the site had been planted with hybrid brachiaria lines for 3 years. The grasses were sprayed with glyphosate (3 L/ha) in May 2011, which is not a normal practice for farmers sowing forages in Thailand, plowed and disked before the guinea grass seeds were sown 3 weeks later on 16 June 2011.

Two guinea grass cultivars (Mombasa and Tanzania) were sown at 6 sowing rates (2, 4, 6, 8, 10 and 12 kg/ha) in 4 m x 3 m plots in a randomized complete block design with 4 replications. Prior to sowing, a germination test on the seeds showed 70% germination. The seeds were hand-broadcast on to the seed beds and lightly surface raked into the soil. The plots were fertilized at sowing with N:P:K (15:15:15) at 200 kg/ha and lime at 1,000 kg/ha.

Plant counts were made in four 0.25 m$^2$ quadrats per plot, 4 weeks after sowing. Forage cuts at 5 cm from ground level from four 0.25 m$^2$ quadrats per plot, were taken in the first wet season on 2 August, 16 September and 1 November 2011, in the first dry season on 25 April 2012, in the second wet season on 7 June, 23 July, 6 September and 24 October 2012 and in the second dry season on 23 April 2013, when the study ended.

At the first cut (7 weeks after sowing, on 2 August 2011), plant and tiller numbers/m$^2$ were counted in the 4 quadrats per plot and tiller length measured in situ on 20 tillers per plot. These tillers were cut, leaf number per tiller counted, and the length and width of a leaf from the top, middle and base of each tiller measured. At all cuts, the quadrat samples were sorted into guinea grass and weeds and weighed fresh, and a 300 g subsample was taken from the guinea grasses, sorted into leaves and stems and dried at 70 °C for 48 h to calculate dry weights of tillers, stems and leaves and total DM.

After sampling, all plots were cut to about 5 cm above ground level, the forage was removed and the plots were fertilized with N:P:K (15:15:15) at 200 kg/ha.

Data from the trial were analyzed by analysis of variance, using the IRRISTAT program from the International Rice Research Institute (IRRI). Entry means were compared by LSD at P=0.05 probability level.

## Results

### *Rainfall*

Rainfall in the first year from sowing (June 2011) until October 2011 was 28% higher than the 12-yr mean for the same period (Figure 1), with particularly heavy rainfall in August 2011. For the same period in the second year, rainfall was 30% lower than the 12-yr mean. Rainfall in the second dry season (Nov 2012–Apr 2013) was nearly 40% lower than the 12-yr mean.

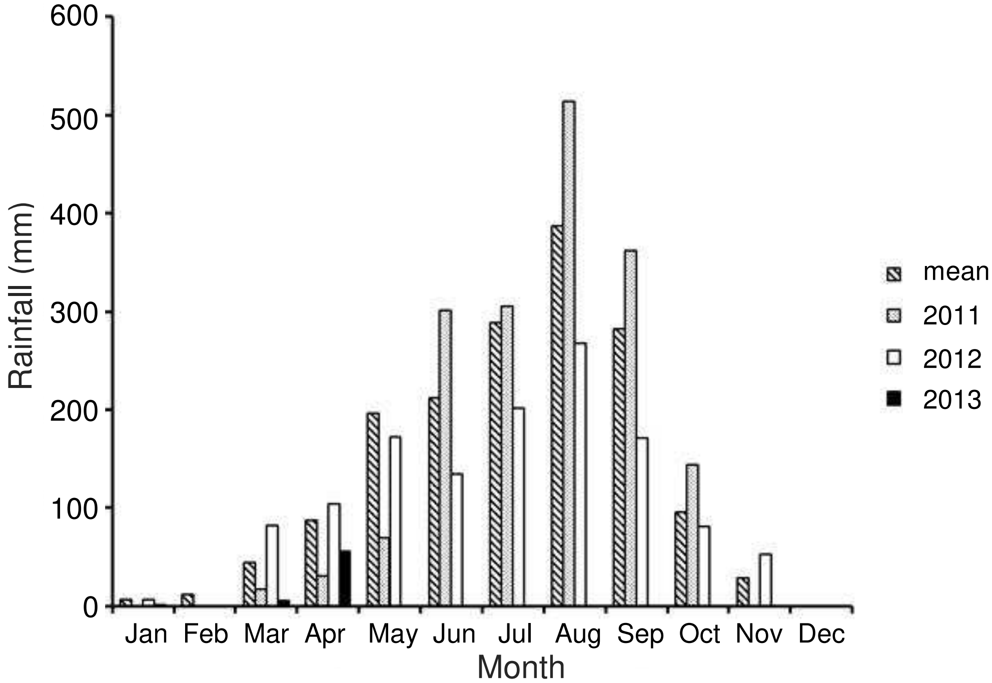


**Figure 1.** Rainfall at the Amnart Charoen meteorological station, 9 km from the research site, during the trial and the 12-yr mean (2000−2012).

*Plant and tiller numbers*

Plant populations at 4 and 7 weeks after sowing increased with increasing sowing rate up to 8 kg/ha (P<0.05), with plots sown at 8 kg/ha having twice as many plants as those sown at 2 kg/ha (Table 1). Across sowing rates, plant populations were similar (P>0.05) for both cultivars, but at a sowing rate of 12 kg/ha, Tanzania produced significantly more plants/m$^2$ (141) than Mombasa (99) (P<0.05).

Tiller numbers increased significantly with sowing rates up to 8 kg/ha (Table 1), and with age, particularly at low sowing rates. Between 7 and 20 weeks after sowing, tiller numbers increased 62% in plots sown at 2 and 4 kg/ha compared with 17% in the 12 kg/ha plots. At the end of the first dry season (25 April 2012), tiller numbers were significantly greater in plots sown at 8–12 kg/ha than in plots sown at 2 kg/ha (Table 2). By the end of the second wet season (24 October 2012), tiller numbers were greater in plots sown at 8−12 kg/ha than in

**Table 1.** Effects of sowing rate and guinea grass cultivar on plant establishment at 4 and 7 weeks after sowing and tiller numbers at 7, 13 and 20 weeks after sowing (first wet season).

| Sowing rate (kg/ha) | Plants/m$^2$ | | Tillers/m$^2$ | | |
|---|---|---|---|---|---|
| | 4 wk | 7 wk | 7 wk | 13 wk | 20 wk |
| 2 | 39 | 51 | 151 | 159 | 243 |
| 4 | 54 | 61 | 171 | 225 | 280 |
| 6 | 79 | 77 | 190 | 207 | 281 |
| 8 | 92 | 104 | 233 | 240 | 303 |
| 10 | 106 | 110 | 233 | 255 | 322 |
| 12 | 106 | 120 | 279 | 258 | 326 |
| LSD (P<0.05) | 19.3 | 17.5 | 39.4 | 33.4 | 28.0 |
| Cultivar | | | | | |
| Mombasa | 84 | 87 | 190 | 204 | 263 |
| Tanzania | 75 | 88 | 228 | 242 | 322 |
| LSD (P<0.05) | ns | ns | 22.7 | 19.3 | 16.1 |
| Sowing x cultivar | ns | * | * | * | * |

**Table 2.** Effects of sowing rate and guinea grass cultivar on tiller numbers/m$^2$ at the ends of the first dry season, second wet season and second dry season.

| Sowing rate (kg/ha) | First dry season 25 Apr 2012 | Second wet season 24 Oct 2012 | Second dry season 23 Apr 2013 |
|---|---|---|---|
| 2 | 282 | 304 | 323 |
| 4 | 295 | 308 | 342 |
| 6 | 305 | 306 | 346 |
| 8 | 315 | 339 | 365 |
| 10 | 320 | 336 | 359 |
| 12 | 325 | 337 | 339 |
| LSD (P<0.05) | 33 | 24 | ns |
| Cultivar | | | |
| Mombasa | 283 | 300 | 327 |
| Tanzania | 325 | 343 | 365 |
| LSD (P<0.05) | 19 | 14 | 24 |
| Sowing x cultivar | ns | ns | ns |

those sown at 2−6 kg/ha (Table 2). At the end of the second dry season (23 April 2013), all plots had similar tiller numbers (range 323–365 tillers/m$^2$) (Table 2).

Tanzania produced approximately 20% more tillers than Mombasa in the first wet season (Table 1), and retained an advantage until the termination of the trial, when Tanzania averaged 365 tillers/m$^2$ and Mombasa 327 tillers/m$^2$ (Table 2). In the first wet season, both cultivars had similar tiller numbers at low sowing rates (2−4 kg/ha) (P>0.05) but at higher sowing rates (8−12 kg/ha), Tanzania produced significantly more tillers/m$^2$ than Mombasa.

*Tiller and leaf measurements*

Tiller heights and leaf lengths generally increased as sowing rate increased but differences between sowing rates, 4−12 kg/ha, were mostly not significant (Table 3). Mombasa grew significantly taller tillers, longer leaves and wider leaves but fewer leaves per tiller than Tanzania (P<0.05) (Table 3).

Plants produced from low sowing rates had significantly heavier tillers than plants from high sowing rates throughout the trial (Table 4). Mombasa produced significantly heavier tillers than Tanzania until the end of the second wet season (Table 4). At the final cut (end of second dry season), tiller weights in all plots were less than half the weight of tillers harvested 6 months earlier and were lower than tiller weights at the first cut of the trial.

**Table 3.** Effects of sowing rate and guinea grass cultivar on tiller height, number of leaves/tiller, leaf length and leaf width at 7 weeks after sowing.

| Sowing rate (kg/ha) | Tiller height (cm) | Leaves/ tiller | Leaf length (cm) | | | Leaf width (cm) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Middle | Bottom | Top | Middle | Bottom |
| 2 | 80.1 | 3.8 | 55.4 | 46.5 | 36.4 | 1.91 | 1.79 | 1.67 |
| 4 | 92.1 | 3.6 | 63.4 | 53.2 | 39.7 | 2.09 | 1.96 | 1.77 |
| 6 | 93.7 | 3.7 | 63.4 | 53.3 | 41.0 | 2.05 | 1.93 | 1.76 |
| 8 | 95.5 | 3.5 | 65.7 | 56.7 | 41.9 | 1.99 | 1.89 | 1.74 |
| 10 | 99.9 | 3.4 | 68.0 | 58.7 | 43.5 | 2.07 | 1.92 | 1.74 |
| 12 | 96.2 | 3.5 | 64.6 | 59.1 | 43.7 | 1.97 | 1.92 | 1.69 |
| LSD (P<0.05) | 9.51 | ns | 7.0 | 7.6 | 4.8 | ns | ns | ns |
| Cultivar | | | | | | | | |
| Mombasa | 104.2 | 3.2 | 70.6 | 61.2 | 46.3 | 2.09 | 1.98 | 1.84 |
| Tanzania | 81.6 | 4.0 | 56.2 | 47.9 | 35.8 | 1.94 | 1.83 | 1.62 |
| LSD (P<0.05) | 5.5 | 0.14 | 4.0 | 4.4 | 2.8 | 0.12 | 0.12 | 0.08 |
| Sowing x cultivar | ns | ns | ns | ns | ns | ns | ns | ns |

**Table 4.** Effects of sowing rate and guinea grass cultivar on tiller dry weight (g) during the first wet season and at the ends of the first dry season, second wet season and second dry season.

| Sowing rate (kg/ha) | First wet season | | | First dry season | Second wet season | Second dry season |
|---|---|---|---|---|---|---|
| | 2 Aug 2011 | 16 Sep 2011 | 1 Nov 2011 | 25 Apr 2012 | 24 Oct 2012 | 23 Apr 2013 |
| 2 | 0.97 | 1.01 | 0.98 | 0.97 | 1.19 | 0.63 |
| 4 | 0.99 | 0.93 | 0.99 | 0.77 | 1.18 | 0.54 |
| 6 | 0.98 | 0.89 | 0.92 | 0.75 | 1.16 | 0.49 |
| 8 | 0.91 | 0.89 | 0.97 | 0.57 | 1.01 | 0.46 |
| 10 | 0.83 | 0.78 | 0.85 | 0.61 | 1.03 | 0.47 |
| 12 | 0.82 | 0.80 | 0.85 | 0.42 | 0.98 | 0.46 |
| LSD (P<0.05) | 0.26 | 0.15 | 0.11 | 0.23 | 0.12 | 0.11 |
| Cultivar | | | | | | |
| Mombasa | 1.17 | 1.01 | 1.07 | 0.75 | 1.31 | 0.52 |
| Tanzania | 0.67 | 0.76 | 0.78 | 0.61 | 0.88 | 0.50 |
| LSD (P<0.05) | 0.15 | 0.08 | 0.07 | 0.13 | 0.06 | ns |
| Sowing x cultivar | * | ns | ns | ns | ns | ns |

*Dry matter production*

Guinea grass sown at 2 kg/ha produced lower DM yields (P<0.05) than when sown at 8 and 12 kg/ha for the first and second forage cuts in the first wet season (Table 5), with yields at other sowing rates being intermediate. However, by the third cut (1 November 2011), yields were similar for all sowing rates, and by the end of the first dry season, yields were inversely related to sowing rate (P<0.05). Plots sown at 2 kg/ha produced 12–92% more DM than the other sowing rates (Table 5).

In the second wet season and second dry season, all plots produced similar DM yields, averaging 14,890 kg/ha from 4 cuts in the second wet season and 1,750 kg/ha from a single cut in the second dry season.

Mombasa produced 23% more DM than Tanzania from 3 cuts in the first wet season, but DM yields were similar in the first dry season (Table 5). In the second wet season, Mombasa again produced 23% more DM than Tanzania (16,433 vs. 13,350 kg DM/ha) with similar DM yields (1,750 kg DM/ha) in the second dry season (November 2012–April 2013).

*Leaf %*

The percentage of leaf DM was similar for all sowing rates throughout the trial, with a higher proportion of leaf in the dry season compared with the wet season. The proportions of leaf DM in the first and second wet seasons averaged 75 and 73%, respectively, and 81 and 87% in the first and second dry seasons.

Mombasa and Tanzania produced similar leaf DM proportions in the first wet season (75%) but in the second wet season, Tanzania produced a higher proportion of leaf (75%) than Mombasa (71%). In the first dry season, Tanzania produced a greater proportion of leaf (82%) than Mombasa (79%) but in the second dry season, both cultivars produced similar leaf proportions of 86−87%.

*Weed %*

The main weed species was the annual species, *Richardia brasiliensis,* which was prevalent in the first wet season but died off during the first dry season and was not recorded for the remainder of the trial. In the first wet season, plots sown at the lowest sowing rate had a significantly higher proportion of weeds than plots sown at the higher sowing rates (Table 6). Overall, Tanzania plots were more weedy than Mombasa plots in the first wet season. At the first cutting, Mombasa plots sown at 2 kg/ha were more weedy than Tanzania plots sown at a similar rate, and at the second cutting, Mombasa and Tanzania plots sown at 2 and 12 kg/ha had similar proportions of weeds.

## Discussion

This study has shown that guinea grass pastures can be established successfully with sowing rates as low as 2 kg/ha, provided that land preparation is good, and sowing rates above 4 kg/ha produce no extra DM. While higher sowing rates did produce more DM during the first 3 months after sowing than sowing at 2 kg/ha, thereafter there was no advantage in total DM production from using sowing rates as high as 12 kg/ha.

**Table 5.** Effects of sowing rate and guinea grass cultivar on dry matter production (kg/ha) during the first wet season and at the end of the first dry season.

| Sowing rate (kg/ha) | First wet season | | | First dry season |
|---|---|---|---|---|
| | 2 Aug 2011 | 16 Sep 2011 | 1 Nov 2011 | 25 Apr 2012 |
| 2 | 1,411 | 1,597 | 2,345 | 2,702 |
| 4 | 1,676 | 2,123 | 2,697 | 2,311 |
| 6 | 1,826 | 1,785 | 2,501 | 2,248 |
| 8 | 2,051 | 2,071 | 2,836 | 1,781 |
| 10 | 1,857 | 1,970 | 2,717 | 1,807 |
| 12 | 2,108 | 2,006 | 2,743 | 1,410 |
| LSD (P<0.05) | 503 | 394 | ns | 264 |
| Cultivar | | | | |
| Mombasa | 2,202 | 2,059 | 2,799 | 2,106 |
| Tanzania | 1,441 | 1,791 | 2,480 | 1,979 |
| LSD (P<0.05) | 290 | 228 | 212 | ns |
| Sowing x cultivar | * | ns | ns | ns |

**Table 6.** Effects of sowing rate and guinea grass cultivar on the proportion of weeds (%) in the fresh herbage.

| Sowing rate (kg/ha) | First wet season | | |
|---|---|---|---|
| | 2 Aug 2011 | 16 Sep 2011 | 1 Nov 2011 |
| 2 | 53.5 | 35.0 | 18.0 |
| 4 | 49.3 | 23.6 | 11.0 |
| 6 | 48.1 | 22.6 | 13.5 |
| 8 | 41.9 | 21.5 | 8.9 |
| 10 | 43.3 | 18.6 | 10.1 |
| 12 | 37.9 | 21.3 | 6.9 |
| LSD (P<0.05) | 13.6 | 8.4 | 5.9 |
| Cultivar | | | |
| Mombasa | 38.6 | 18.8 | 9.1 |
| Tanzania | 52.8 | 28.7 | 13.7 |
| LSD (P<0.05) | 7.9 | 4.8 | 3.4 |
| Sowing x cultivar | * | * | ns |

Guinea grass sowing rates from other countries vary from 2−3 kg/ha up to 10 kg/ha. In Australia, 2−7 kg/ha has been recommended, depending on the age and quality of seed (McCosker and Teitzel 1975). In South America, Acosta et al. (1995) and Spain et al. (1984) recommended sowing guinea grass at 8−10 kg/ha because of low seed germination and purity. FAO recommendations are for sowing rates of 1−2 kg/ha for cv. Hamil and 3.5−4.5 kg/ha for common guinea (FAO 2005). Cook et al. (2005) also recommended a general sowing rate of 2−3 kg/ha for all tropical regions.

Plants that established from low sowing rates compensated for fewer tillers/m$^2$ by producing bigger and heavier tillers than plants that established from higher sowing rates. This compensation enabled low sowing rates to produce similar DM yields to higher sowing rates after the initial period of establishment. During the first dry season, DM yields from low sowing rates exceeded those from the higher sowing rates, which could be a function of more efficient moisture utilization by the smaller number of plants on a given area. Fewer and stronger plants/m$^2$ are preferable to lots of weaker plants, particularly in tropical environments with distinct wet and dry seasons, where stronger plants are able to withstand animal foraging and treading and climatic stresses better than weaker plants (Cook et al. 1993a).

Some of the most important considerations in establishing a pasture are the amount of seed which germinates and emerges, and the number of seedlings which then survive and develop into mature plants (Cook et al. 1993b). Based on the numbers of seeds we sowed at the various sowing rates and plant numbers that were present 4 weeks after sowing, we calculated that only 10–15% of seed sown at 12 kg/ha and 25–35% of seed at 2 kg/ha actually produced a live plant. The low sowing rate was much more efficient in terms of live plants per kg of seed sown.

Humphreys (1987) stated that a low sowing rate is successful only if ground preparation and weed control are faultless, and that in areas receiving more than 1,000 mm annual rainfall, sowing rates preferably should be 10–12 kg/ha of good quality seed. In our study, soil preparation was very good, producing a fine tilth, and there was emphasis on seed placement and depth of sowing, plus seed coverage, which are important considerations when sowing small-seeded pasture species (Cook et al. 1993b). However, weed control post-sowing was absent, with large amounts (38–53%) of *Richardia brasiliensis* growing in the plots in the first 7 weeks of establishment. As a result, low sowing rate plots (2 kg/ha) were significantly more weedy in the first wet season than plots sown at higher rates, probably because of lower competition for light, moisture and nutrients. However, after 3 defoliations in the first wet season, this annual weed died out during the first dry season and did not regenerate in the second wet season, when guinea grass plants dominated in all plots.

Mombasa grew 27% taller and 43% heavier tillers, and 28% longer and 10% wider leaves than Tanzania in this study. Even though Tanzania grew 16% more tillers/m$^2$ than Mombasa, the production of larger tillers and leaves enabled Mombasa to produce 23% more DM than Tanzania in successive wet seasons, similar to results in an earlier cutting trial in the same region (Hare et al. 2013a). This greater DM production from Mombasa has resulted in Mombasa now replacing Tanzania in many villages that produce fresh forage for sale (Nakamanee et al. 2008). Furthermore, demand for Mombasa seed has come from other livestock farmers in Thailand, who are attracted by the tall structure and large leaves of Mombasa, which are considered important attributes by these farmers for forages in cut-and-carry forage systems.

The annual DM yields (15–18 t/ha second year) for both cultivars were below guinea grass yields of 20–30 t/ha commonly reported elsewhere (Cook et al. 2005). Under high inputs of fertilizer and dry season irrigation, annual DM yields of 33–46 t/ha (Nakamanee et al. 2008) and 50 t/ha (Udchachon et al. 1998) for Tanzania have been reported in Thailand. In this study with no dry season irrigation, only 1 forage cut was possible in each dry season. Although guinea grasses are considered to have only moderate drought tolerance of 4–5 months (Cook et al. 2005; FAO 2005), Mombasa and Tanzania survived very dry conditions, which did suppress growth. In the second dry season with rainfall 40% below the mean, tiller weights for both cultivars were less than half the weights in the previous wet season.

While we have demonstrated that low sowing rates can be successful under good sowing conditions, how these results relate to commercial conditions is open for debate. With good soil preparation and pre-sowing weed control, there was definitely no medium-term advantage in sowing at rates above 4 kg/ha and higher sowing rates would be indeed wasteful. However, farmers who plant forages in Thailand do not spray weeds before cultivation, usually roughly cultivate and do not cover the sown seeds with soil, exposing the seeds to high radiation and high temperatures. In addition, it may be difficult for farmers to sow the small guinea grass seeds at a 2 kg/ha sowing rate. More work is needed to determine how effectively lower sowing rates can be applied under the conditions used by farmers at sowing. If farmers are prepared to improve their soil preparation and pay more attention to sowing techniques, there is scope for them to significantly reduce the amounts of seed sown and hence seed costs.

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