Differences in *Urochloa* hybrids and cultivars biomass production in several sites in western Kenya

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Abstract

Forage production is at the core of improved livestock productivity, especially in sub Saharan Africa. The genetic potential of existing animals remains underutilized due to limited forage quality and quantity. Albeit wide range of forage germplasm that exists, little data is available for identifying suitable genotypes, matched to specific environments and production systems. Due to the spatial and temporal diverse environments in which livestock production happens, multi-locational screening of forage production and characterizing genotype by environment interaction is key. We selected seven *Urochloa* (Syn. *Brachiaria*) genotypes comprising three hybrids and four cultivars and established them in on-farm trials in western Kenya for dry matter evaluation and nutritional quality. We selected eight sites covering four administrative counties (Siaya, Kakamega, Busia, Bungoma), and each county hosting two replicated trials, with each trial replicated 3 times. We observed dry matter yield differences across the counties in the order Bungoma > Busia > Kakamega > Siaya. Similarly, the genotypes returned varied performance across the sites. Hybrids did well in one of the county, a mix of hybrids and cultivars in two counties and cultivars in the last county. Amongst sites, variation was least in Busia, and more pronounced in Bungoma. Continued assessments in subsequent cuts are underway. These will feed into context-specific recommendations about suitable forages for sustainable intensification in the face of global warming.

Introduction

Feeds and forages account for 50–70% of costs in livestock production (Odero-Waitituh 2017). Persistent low livestock productivity in sub Saharan African (SSA) countries is largely attributable to insufficient feeds and forages. This goes against growing demand for animal source foods projected to double by 2030 (World Bank 2014), due to human population growth, urbanisation and changing diet patterns. Essentially, livestock production will have to grow to meet the projected demand. Meat and milk demand are growing at 2.8 and 2.2% respectively. The estimated consumers' demand of 35 and 83 billion tons for meat and milk respectively by 2050 (World Bank 2014) will remain unmet if livestock feeding remain inadequately addressed. However, pressure on land is also increasing with smallholder systems no longer able to allocate land for grazing, necessitating and leading to intensified production, especially for dairy. Therefore, productive forage technologies suitable for intensification are desirable to address for livestock increased productivity. *Urochloa* forage species including its hybrids are successful in Latin America, supporting improved livestock productivity especially beef (Rivas and Holmann 2005). Similarly, this is possible in African tropics, especially in the humid and sub-humid environments, where dairy production dominates. While a wide range of livestock forages -including species, cultivars and hybrids- exist (http://www.tropicalforages.info/), matching genotypes to biophysical environment remains unsatisfactory in order to identify the most biophysical suitable lines that additionally match with the agricultural farming context.

We therefore, assessed under on-farm context, *Urochloa* hybrids and cultivars for their suitability in western Kenya, where despite dairy potential, a profound production gap prevails.

Materials and Methods

Site selection

We selected four counties in western Kenya based on dairy potential. The counties namely; Bungoma, Busia Kakamega and Siaya. Despite the areas being mid altitude 900–1800m, they differ (Jaetzold and Schmidt 1983). Bungoma site is in low midland categorised as marginal sugar cane zone at an altitude ranging 1433-1829 m and receive 1536- 1681 mm of rainfall annually. Busia equally in low midland sugar zone at an altitude 1200-1440 m, receiving annual 1585 -1690 mm. Kakamega also in low midland sugarcane zone but at 1300-1550 meters altitude and annual precipitation of 1800mm, while Siaya's is in lower midland zone ranging from LM1 to LM5. In LM4 where we had the trials have an annual average precipitation of 890-1020 mm and at altitude 1320 m. In conjunction with Send a Cow Kenya (SACK), a development partner with many years' experience in the region, We linked to farmer groups that have been working with SACK on improving human nutrition and incomes. Livestock including dairy is one of the common agricultural activities, with milk contributing to household nutrition and incomes. We selected two farmer groups per county and sensitized them about dairy and the importance of animal feeding. We offered them to try out several forage options that could grow well in the region. In the end, the groups offered land where we established demonstration trials. While the project provided forage technologies and technical advice, farmers agreed to provide labour, for e.g. land preparation, planting, weeding and harvesting.

Forage technology design and management

We selected eight forage types comprising of three hybrids and four cultivars from genera *Urochloa.* The hybrids included Cayman, Cobra, and Mulato II while the cultivars were Basilisk, Piata, Xaraes and MG4. As a check, Napier grass (*Cenchrus purpureus* Syn. *Pennisetum purpureum*) from the farmers' farms was included among the treatments. In each site, we planted the forages in 15m^2 plots replicated 3 times, and across the 8 sites. For all forages, we followed the recommended seed-rates of 6 kg/ha for *Urochloa* (Njarui *et al.,* 2016) and for Napier grass we used splits placed at 1m x1 m grids (Mwendia *et al.,* 2017). Because of acidic soils in western Kenya (Kanyanjua *et al.,* 2002), we applied lime at two t/ha. Farmers maintained plots weed-free as necessary.

Forage yield and quality

We harvested biomass every 8 weeks, thereby taking samples for dry matter analysis that we also processed for quality analysis. We implemented quality analysis with near infrared system (NIRs) on samples of one demonstration site/county and focused on metabolizable energy (ME), crude protein (CP), neutral detergent fiber (NDF) and in vitro organic matter digestibility (IVOMD). We derived yield metrics for metabolizable (ME MJ/ha) and crude protein (Kg CP/ha), by combining biomass yields and laboratory analysis results.

Data Analysis

We managed data in Microsoft excel and statistics in GenStat 18th edition

Results and discussion

Forage yields and quality

Forage dry matter yields across the counties were largely in the order Bungoma > Busia > Kakamega > Siaya (Figure 1). Cayman and Cobra hybrids produced similar biomass to cultivars in Bungoma and Busia but more than the cultivars in Kakamega and Siaya. Compared to Napier grass, all hybrids produced less especially in Kakamega and Busia.

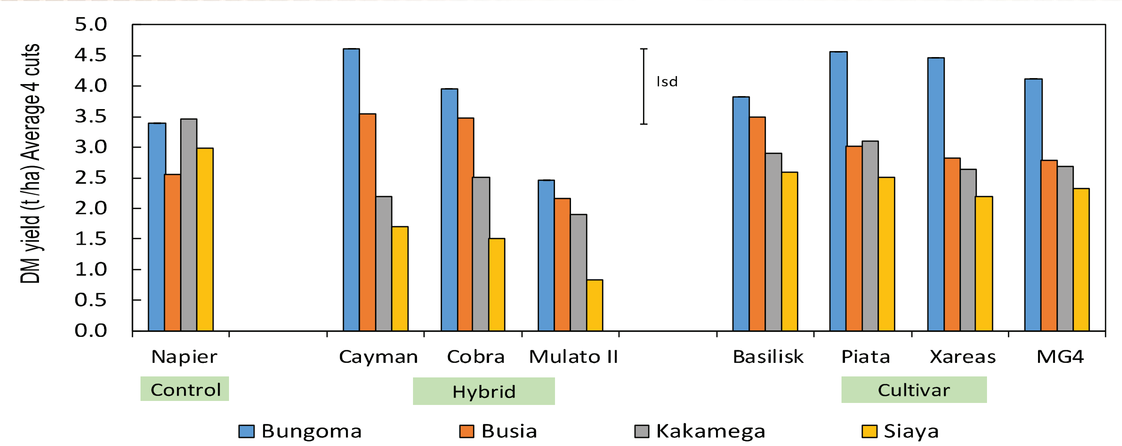

Figure 1: Average biomass yield (four cuts) for Napier grass, *Urochloa* cultivars and hybrids across Bungoma, Busia, Kakamega and Siaya counties in western Kenya, 2019

At forage type level, variability in *Urochloa*, was more pronounced in the hybrids than the cultivars and least in the Napier grass (Fig 1). County yield data revealed more variability in Bungoma County, followed by Kakamega, Siaya and least in Busia (Figure 2).

Crude protein yield (Kg CP/ha) and metabolizable energy yield (ME MJ/kg) had differences (P<0.05) at county level where Busia had most Kg CP/ha and ME MJ/kg than the other counties (Figure 3).

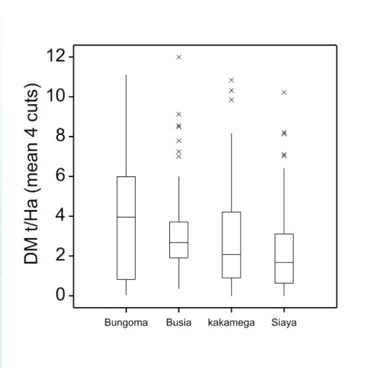

Figure 2: Dry matter yield box-plots for Bungoma, Busia, Kakamega and Siaya counties

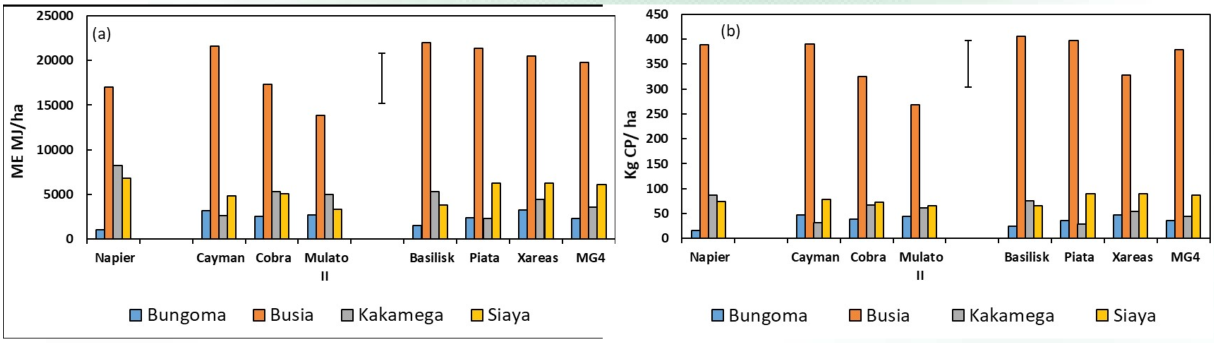

Figure 3: Metabolizable energy (a) and crude protein yield (b) per ha for Napier grass, *Urochloa* hybrids and *Urochloa* cultivars across Bungoma, Busia, Kakamega and Siaya counties in western Kenya. The error bar denote least significant difference.

There was a significant interaction between counties and the forage types for NDF and IVOMD (Table 1).

Table 1: Neutral detergent fiber and invitro organic matter digestibility of Napier grass, *Urochloa* hybrids and cultivars from Bungoma, Busia, Kakamega and Siaya counties based on second harvest in 2019 when the crops had undergone dry season

Attribute	County	Napier	Cayman	Cobra	Mulato II	Basilisk	Piata	Xareas	MG4	P value	lsd
NDF%, (IVOMD %)	Bungoma	66.7 (55.2)	61.4 (56.3)	64.7 (55.6)	59.9 (56.9)	61.6 (56.9)	66.2 (56.3)	65.0 (54.0)	65.4 (56.6)	0.001 (0.002)	3.82 (1.90)
	Busia	63.1 (56.9)	61.7 (60.1)	63.1 (60.7)	62.4 (61.9)	62.0 (59.7)	65.8 (60.8)	69.8 (56.7)	64.3 (62.1)		
	Kakamega	67.6 (54.6)	59.5 (60.4)	59.7 (60.7)	62.9 (60.0)	62.4 (60.9)	64.7 (59.3)	64.7 (57.7)	65.6 (58.6)		
	Siaya	64.9 (53.9)	60.6 (57.0)	65.8 (55.6)	53.8 (56.8)	60.9 (58.5)	66.0 (56.1)	66.5 (55.4)	65.7 (55.7)		

Attribute in brackets correspond to means in brackets along each row further relating to lsd and *P* values in brackets

On the strength of dry matter yields and digestibility, Cayman, Xareas and Mutalo II would be more suitable in Bungoma and other similar environs, especially considering that Napier grass in the area is vulnerable to stunting disease (Kabirigi *et al.,* 2015).

Basilisk, Piata and Cayman and in that order, had the most crude protein yield and the same order for metabolizable energy making them candidates of choice in Busia. However, accumulation of more NDF by Basilisk and Piata than Cayman (Table 1) despite the values being similar is undesirable. Only Napier grass and Xareas had significantly lower digestibility in the County making them least of choice in the area. In Kakamega County, Napier grass resulted in most crude protein yield due to the high dry matter yield (Figure 1) despite the values not being significantly different. Equally, Napier had most ME followed by Cobra > Basilisk. Albeit the competitive yields, Napier accumulating most NDF (Table 1) with subsequent lowest digestibility minimize choice on the Napier grass also exacerbated by stunting disease that is prevalent in the County leaving Cobra and Basilisk as best bet for Kakamega among the test forages.

In Siaya County, Napier grass least digestibility negated it relatively higher ME yield although the values were similar to those of other forages. As such, Piata > Xareas >MG4 crude protein yield, similar to ME yield except for interchange of Xareas and Piata, left the three preferable for Siaya. In general, Bungoma, Busia and Kakamega Counties, had a mix of *Urochloa* hybrids and cultivars doing well, while in Siaya only cultivars and therefore the best bets for forage production.

In conclusion, as we show here, performance of different forage types even within a species vary greatly under similar management at different locations. In the relatively drier site in Siaya than the other sites, *Urochloa* cultivars are preferable to either Napier grass or *Urochloa* hybrids. Therefore, recommendations based on field evaluations are more realistic where various environmental factors interplay and influence genotype performance.

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