Participatory evaluation of *Urochloa* (*Brachiaria*) grasses in the cool highlands of Central Kenya

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Abstract

Grasslands are increasingly threatened by over exploitation, degradation and climate change that has undermined their productive capacity, leading led to inadequate quantity and quality feed. Urochloa grass, a native of eastern Africa has been widely improved and adapted as livestock forage. A farmer participatory study was conducted to evaluate productivity of *eight Urochloa* grasses *(Urochloa brizantha* cv. Marandu, *U. brizantha* cv. Xareas, *U. brizantha* cv. Piata, *U. brizantha* cv. MG4, *U. decumbens* cv. Basilisk, *U. humidicola* cv. Humidicola, *U. humidicola* cv. Llanero and Urochloa hybrid Mulato II) compared to controls of *Pennisetum purpureum (Napier grass cv. Kakamega 1) and Chloris gayana (*Boma Rhodes*)* commonly grown in Kenya. Five farmers' own criteria (ground cover, plant height, hairiness, resistance to pests and diseases, and forage quantity) was used in a Likert scale of 1- 5 (1-very poor, 2-poor, 3-fair, 4-good and 5-very good) in the assessment. Farmers participatory evaluation showed *U. brizantha cv.* MG4 followed by U. decumbens cv. Basilisk were ranked higher ($p<0.05$) on height and amount of forage compared to other *Urochloa* grasses, however, they were rated lower compared to Napier and Rhodes grass controls. There was a significant positive correlation between plant height, and cover ($p<0.001$) with dry matter yield, suggesting that height and cover had a direct linear relationship to dry mater yield. The results demonstrate that the farmers can accurately assess the performance of forages using their own criteria.

Introduction

Grasslands are critical in supporting the livelihoods of over 36% of Kenya's population living in both high rainfall areas and rangelands. The grasslands and rangelands constitute over 80% of the Kenyan land mass that support 70% of the national livestock. Inadequate supply of forage and poor forage qualities are two major impediments to livestock production particularly under smallholder systems in Kenya. Napier grass and Rhodes grass are the major cultivated forage grasses in Kenya due to their wide ecological adaptability, relatively high herbage yield and ease of propagation and management (Nyambati et al., 2010). However, the emerging diseases such as napier napier stunt (Jones et al 2004) threaten the production of Napier grass for livestock feeding. The milk productivity is further restricted by lack of suitable forage types adapted to various environments. *Urochloa* (commonly known as Brachiaria) grass, a native of eastern Africa has been widely adapted as livestock forage. Besides their use as livestock feed, *Urochloa* are also known to contribute significantly to soil improvement (Gichangi et al., 2016). There have been research and development efforts to improve the adaptability, productivity, nutritive value and other agronomic characteristics of *Urochloa* grasses (Nguku et al., 2016; Ngila et al., 2016). This study was part of a larger project of repatriating *Urochloa* grasses back to Kenya and evaluating their adaptability to different environments in Kenya (Njarui et al 2015). Community based farmer participatory approaches are a sustainable means to overcome the socio-economic constraints that limit the adoption of new technologies at the farm level (Noordin et al., 2001; Garcia et al., 2019). The objective of the current study was to understand and document farmers' own knowledge and perceptions of forage production and utilization, use farmer participatory methodology to select and evaluate adapted *Urochloa* grasses for up scaling and adoption in the cool sub-humid highlands of Central Kenya.

Methods and Study site

The productivity of *Urochloa* grasses was evaluated at KALRO Ol Joro Orok Research Centre in the cool highlands of Central Kenya. The Center is located 0˚03'S, 36˚06'E, 2393 m above sea level, with a mean annual rainfall of 980mm and mean temperature of 14^0 (ranging between 8 °C and 22 °C) with occasional night frosts (Jaetzold and Schmidt, 2005) The soil are classified as verto-luvic and chromo-luvic Phaeozems (Sombroek *et al*

1982). Eight Urochloa grasses, *U. brizantha* cv. Marandu, U. brizantha cv. Xareas, U. brizantha cv. Piata, U. brizantha cv. MG4, *U. decumbens* cv. Basilisk, *U. humidicola* cv. Humidicola, *U. humidicola* cv. Llanero and Urochloa hybrid Mulato II were planted in a randomized complete block design with four replications. Two control plots of, *Pennisetum purpureum* (Napier grass Kakamega 1) and *Chloris gayana* (Boma Rhodes) were included in the experiment. The plot size measured 4m by 5m wide and grass seeds were drilled in furrows with an inter row spacing of 0.5 cm. Napier grass was planted using cane cuttings of 3 nodes and at spacing of 1 m X 1 m. Triple super-phosphate (TSP, 26% P_2O_5) fertilizer was applied to the soil prior to planting at a rate of 20 kg ha¹. The plots were kept weed free by hand weeding.

Twenty livestock farmers were engaged in a participatory workshop to developed criteria which were merged in order of similarity to 12. The 12 criteria were further reduced to 5 in order of importance using pair wise comparison method. The 5 criteria (ground cover, hairiness, plant height at harvest (8-10 weeks of cutting back), resistance to pests and disease and the amount of forage (visual growth) were fixed in a Likert scale of 1- 5 (1-very poor, 2-poor, 3-fair, 4-good and 5-very good). The farmers were divided in four groups according to the number of replicates and each group of was allocated a replicate to evaluate. Each farmer in the group did individual ranking of the grasses using a Likert questionnaire form. Scientists also evaluated the grasses using similar criteria. The data were analyzed using PROC MIXED of SAS (SAS, 2002). Means were separated using Fisher's protected least significant difference (LSD) at $P<0.05$. The means of farmer ranks on forage growth parameters were subjected to Pearsons linear correlation procedure to see the correlation significance.

Results and Discussion

Farmer Participatory evaluation and selection of adapted *Urochloa* cultivars

Using the five preferred criteria, farmers were able to evaluate and rate the grasses for forage yield, hairiness, plant height at harvest, ground cover and resistance to pests and disease (Table 1). Based on ground cover, *U. brizantha* cv. MG4 had a significantly higher ranking ($p<0.05$) followed by *U. decumbens* cv. Basilisk compared to other cultivars, but they were rated lower compared to Napier and Rhodes grass controls. *Urochloa brizantha* cv. MG4, Piata and Xaraes and *U. decumbens* cv. Basilisk were rated higher ($P<0.05$) as having less hair compared with the other Urochloa grasses and napier grass control. *Urochloa brizantha* cv MG4 was ranked higher ($p<0.05$), for harvesting height compared with other Urochloa grasses. It was followed in rating by *U. decumbens* cv. Basilisk and *U. brizantha* cv. Piata. The two control grasses of Napier and Rhodes were similar in rating but higher ($p<0.05$) than Urochloa grasses. There was no significant difference between the Urochloa grasses in terms of pest and disease resistance. Based on forage quantity, *Urochloa brizantha* cv MG4 was ranked higher ($p<0.05$), followed by *Urochloa decumbens* cv basilisk, however the Urochloa grasses ranked higher compared to Urochloa grasses.

Table 1(2) Farmers' evaluation of Urochloa grasses

Treatment	Cover	hairiness	Height	Pests and disease	Forage	Average rank across scores
Rhodes	4.49^{a}	4.12^{a}	4.25^{a}	4.29^{a}	4.25^{b}	1
Napier	3.90^{b}	2.94^{cd}	4.51^{a}	4.37^{a}	4.73^{a}	2
U. brizantha cv. MG4	3.69^{bc}	3.92^{ab}	3.201^{b}	4.06^{abc}	3.27^{c}	3
U. decumbens cv. Basilisk	3.55^{bcd}	3.69^{ab}	3.06^{bc}	4.18^{abc}	3.02^{cd}	4
U. brizantha cv. Piata	3.45^{bcd}	3.98^{ab}	2.78^{bcd}	4.24^{ab}	2.92^{cde}	5
U. brizantha cv. Marandu	3.23^{cd}	3.45^{bc}	2.43^{de}	3.75^{bc}	2.51^{e}	7
U. brizantha cv. Xareas	3.12^{d}	3.86^{ab}	2.71^{cd}	3.96^{abc}	2.75^{de}	6
U. humidicola cv. Llanero	2.12^{e}	3.45^{bc}	1.73^{fg}	3.65^{c}	1.63^{g}	8
U. humidicola cv. Humidicola	1.90^{e}	3.49^{bc}	1.55^{g}	3.64^{c}	1.61^{g}	10
Urochloa hybrid Mulato II	1.86^{e}	2.76^{d}	2.06^{ef}	3.73^{c}	2.08^{f}	9

Means with the same superscripts are not significantly different at $p<0.05$

Across all the criteria, the most preferred *Urochloa* grasses by the farmers were MG4, Basilisk, Piata and Xaraes. However, the ranking of *Urochloa* grasses were lower compared to both Napier and Rhodes grass controls. The ranking of grasses by farmers was similar to that based on scientists' empirical data from the same study (Nyambati et al, 2016). There was a significant positive correlation between height (0.723, $p<0.0001$) and forage yield, and between cover and forage yield (0.56; $p<0.0001$) suggesting that farmers rank estimate using height and cover had a direct linear relationship to forage yield. The farmers' preference for cultivars MG4, Piata and Basilik concurred with findings of Nguku et al (2016) in the eastern lowlands of Kenya and Garcia et al, 2019 in Central America. These grasses have a decumbent growth habit which makes it to form a dense plant spread and cover. The farmers' considerations implied that plant height and ground cover are among important factors in determining forage yield. The correlations between forage yield and morphological parameters of height and cover are in agreement with those reported by Munyasi et al (2015), implying that height and cover could be used to assess biomass yield. Skerman and Riveros, (1990) showed that pasture species which grow fast and tall are more efficient in use of resources and therefore more competitive and productive. This relationship concurs with Studies by Tessema et al (2003) who showed that increasing foliage height increased biomass yield in forage grass. The involvement of farmers in evaluating the Brachiaria grasses is likely to enhance adoption and utilization as previous studies have shown that community based farmer participatory approaches are a sustainable means to overcome the socio-economic constraints that limit the adoption of new technologies at the farm level (Noordin et al., 2001). The farmers are able observe and reflect the merits and demerits of the technologies and thereby make informed decisions on whether or not to adopt them.

Conclusions

Farmers' participatory evaluation showed higher preference for forage biomass, height at harvesting and ground cover for *Urochloa brizantha* cv. MG4, Piata and Urochloa decumbens cv. Basislisk. However, the preference for *Urochloa* was less compared to the commonly used Napier and Rhodes grass in Kenya. There was a significant positive correlation between plant height with forage quantity. This implied that the tallest grass with most ground cover produced greater quantity of forage. The farmers' selection criteria were in agreement with scientists' evaluation based on measured forage productivity parameters. Therefore, height, cover and visual assessment of biomass could be used as indicators for assessing forage productivity based on farmers' own local technical knowledge, in assessing the biomass productivity. This study identified adapted and promising Brachiaria cultivars that have potential to effectively address the challenge of feed unavailability in the cool highlands of central Kenya. Targeted dissemination and up-scaling of adapted Brachiaria grass cultivars accompanied with training on appropriate agronomic and feeding practices is recommended to enhance their uptake for improved livestock production in Kenya.

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