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Mwangi Gatheru
Kenya Agricultural and Livestock Research Organisation, Kenya

C. N. Ondiko
Kenya Agricultural and Livestock Research Organisation, Kenya

W. Ayako
Kenya Agricultural and Livestock Research Organisation, Kenya

M. C. Mutoko
Kenya Agricultural and Livestock Research Organisation, Kenya

Elias M. Gichangi
Kenya Agricultural and Livestock Research Organization, Kenya

See next page for additional authors

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Mwangi Gatheru, C. N. Ondiko, W. Ayako, M. C. Mutoko, Elias M. Gichangi, and Donald M. G. Njarui

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Participatory evaluation and selection of improved *Urochloa* grass cultivars in Kenya

Gatheru, M.[1], Ondiko, C.N.[2], Ayako, W.[3], Mutoko, M.C,.[4] Gichangi, E.M.[1]and Njarui D.M.G.[1]*

[1]Kenya Agricultural and Livestock Research Organization (KALRO), Katumani, Kenya
[2]KALRO, Mtwapa, Kenya
[3]KALRO- Naivasha, Kenya
[4]KALRO, Kitale, Kenya

*****Corresponding author email: mwangigatheru@yahoo.com

Abstract
Low adoption of superior agricultural technologies has been attributed to insufficient attention given to farmers' priorities and perceptions while developing technologies. There is therefore a need to involve farmers in development of new forage technologies in order to increase adoption. Participatory variety selection (PVS) was conducted on eight *Urochloa* grass cultivars in the coastal lowlands, eastern midlands, central highlands and northwestern highlands of Kenya to select cultivars that are more adaptable in each region. The eight *Urochlo*a cultivars; *U. brizantha* cvs. Marandu, Xaraes, Piatã, MG4, *U. decumbens* cv. Basilisk, *U. humidicola* cvs. Llanero and Humidicola, and *U. hybrid* cv. Mulato II were evaluated against cultivated local grasses; Rhodes grass (*Chloris gayana* cv. KATR3) and Napier grass (*Pennisetum purpureum* cv. Kakamega 1). In each region, farmers were engaged in development of selection criteria through focus group discussions. For each criterion, farmers' scored on individual grass cultivars using a Likert scale of 1 to 4 with higher scores indicating high cultivar preference. Farmers considered 12 to17 plant attributes in the selection of the most suitable forages for planting. The attributes included plant height, colour, spread, biomass among others. MG4 was the most preferred *Urochloa c*ultivar in eastern midlands, central and northwestern highlands while Mulato II was most preferred in coastal lowlands. The study concluded that, the selected *Urochloa* cultivars met the farmers' needs and were advanced for on-farm testing and evaluation for livestock benefits.

Key words: Focus group discussion, Likert scale, pairwise ranking matrix, participatory variety selection

Introduction

There is low adoption of improved forages among smallholder farmers in Kenya. The decision on whether to adopt or not to adopt a new technology is influenced by economic, technological and socio-cultural factors (Eseonu and Egbue, 2014). In the past, researchers evaluated and selected forages without farmer participation after which the forages were passed on to farmers. Unfortunately, technologies selected through this approach often failed to fulfill farmers' expectation and this resulted in low adoption (Gabunada et al., 1997).

Participatory varietal selection (PVS) has been found to be an effective tool in addressing the problem of low adoption of new crop varieties in many countries (Islam et al. 2008). The PVS helps in identification of the needs of farmers by discovering what crops they grow, and what traits they consider important when selecting varieties suitable for their agro-ecological and sociocultural environment (Paris et al. 2011). For instance, PVS was used successfully in identification of preferred traits of Napier grass (*Pennisetum purpureum*) in northern Tanzania (Sikumba et al. 2015).

In a programme to improve livestock production in East Africa, *Urochloa (commonly known as brachiaria)* grass cultivars selected and improved in Latin America were introduced in Kenya. *Urochloa* species adapt to diverse habitats ranging from shaded to open and desert to swampy areas (Miles et al. 1996). Consequently, the grasses have great potential in the intensification of livestock production systems as sown forages in Kenya. In order to enhance adoption of these grasses, the PVS approach was used to identify farmers' preferred traits in selection of suitable forage grasses for integration into the farming systems of four regions in Kenya.

Method

The study was carried out at the Kenya Agricultural and Livestock Research Organization (KALRO) centres at Mtwapa (3º36'S, 39º44'E) in the coastal lowlands, Katumani (1˚58'0''S, 37˚28'0''E) in the eastern midlands), Ol Joro Orok (0˚03'S, 36˚06'E) in the central highlands and Kitale (1°0′6.6′′N, 34° 59′10′′E) in the northwestern highlands.

Eight cultivars; *Urochloa brizantha* cvs. Marandu, Xaraes, Piatã, MG4, *Urochloa decumbens* cv. Basilisk, *Urochloa humidicola*, cvs. Humidicola and Llanero and *Urochloa hybrid* Mulato II were compared with commonly grown grasses; Napier grass cv. Kakamega 1 and Rhodes grass (*Chloris gayana*) cv. KAT 3. In each region, the criteria used by farmers in the selection of suitable grass cultivars were developed through focus group discussions (FGDs). Researchers and extension workers guided farmers in development and prioritizing the most important criterion through pairwise ranking matrix. During the evaluation, farmers scored the individual grass cultivars based on selected phenotypic traits (Table 1) using a Likert scale of 1 to 4 where; 1 = poor, 2 = fair, 3 = good and 4 = very good. Between 60 and 112 farmers participated in the evaluation and selection of *Urochloa* grasses at the four sites. Three evaluations were conducted in each site at different stages of growth.The mean scores for each cultivar averaged over all criteria considered was calculated using Microsoft Excel. The mean scores were subjected to Analysis of Variance (ANOVA) and where significant differences occurred, means were separated by the least significant difference (LSD) test using the statistical software Genstat 15 for windows (VSN Int. 2013).

Results

Farmers' selection criteria

Farmers identified 12 to 17 plant attributes for selecting forages and the order of importance differed across the region (Table 1). The plant attributes ranged from morphological, agronomic as well as the benefits of forages to livestock productivity. Although there were similarities between sites for some of the plants attributes considered, only drought tolerance and high herbage yield were universal across all the sites. In the coastal lowlands, forages that are less hairy and produce high number of tillers had the highest ranking while in the eastern midlands and northwestern highlands, forages that give high milk production after being fed to livestock were most preferred. In the central highlands, forages that produce high biomass had the highest ranking followed by those that were less hairy.

Farmers' evaluation of grasses

Table 2 shows the results of farmers' evaluation in the respective regions. Humidicola was not evaluated in coastal lowlands, eastern midlands and northwestern highlands due to poor establishment while Napier grass dried in the eastern midlands. There were significant ($p< 0.05$) differences among the grass cultivars within all the sites. In the central highlands the control (Rhodes grass) had higher score than all the *Urochloa* cultivars, while in the other sites, some of the *Urochloa* cultivars had lower or higher scores than the controls. In the coastal lowlands, Mulato II, Xaraes and Marandu had the highest score while Basilisk and MG4 had the lowest score. In the eastern midlands, MG4 had the highest score followed by Basilisk while Llanero and Marandu had the lowest mean scores. In both central and northwestern highlands, MG4, Basilisk, Piatã and Xaraes had the highest score while Mulato II and Llanero had the lowest score and the mean scores for the respective grass cultivars was different between sites.

Discussion

There were variations on the plants attributes considered in selection of suitable forages between sites. These variations were perhaps due to differences in social economic and farming system. However, the farmers' criteria in selecting *Urochloa* cultivars were similar to the findings of Cheruiyot et al. (2020) who reported a range of several criteria. The fact that drought tolerant and high herbage yield were common in all the sites, indicate the importance of these attributes in all the regions. One of the effects of climate change is drought that has become a common phenomenon while the declining land sizes necessitates high yielding forages per unit area in order to meet livestock feed demand. Preference of less hairy forages in costal lowlands and central highlands was associated with cut-and-carry feeding systems at the expense of grazing due to limited size. On the other hand, preference for forages that give high milk production when fed to livestock was mainly to meet high demand for milk in eastern midlands and northwestern highlands region

In the eastern midlands, central and northwestern highlands, the *Urochloa* grass cultivars with highest scores largely agreed with the results of agronomic evaluation where the selected cultivars gave higher dry matter

yields (Njarui et al. 2016). MG4 was highly ranked in the three sites and was among the high yielding cultivars Nevertheless, although Mulato II did not produce the highest dry matter yield, it had the highest score in coastal lowlands due to its tolerance to drought and green colour. These results agree with a study in Rwanda (Mutimura and Everson, 2012) where farmers preferred Mulato II due to its adaptability to low rainfall, and acidic soil and remained green throughout the year. It is quite clear that farmers have a wide knowledge on forages and generally consider a wide range of criteria in selection of forages to meet their needs. Scientists, in development of forages should incorporate these criteria in future in order to improve adoption. The study recommended further evaluation to assess other characters not considered since farmers'participatory evaluation was based on phenotypic traits only.

Table 1. Characteristics and farmers' ranking of suitable forages using pairwise ranking matrix in coastal lowlands, eastern midlands, central and northwestern highlands of Kenya

Characteristic	Region			
	Coastal lowlands	Eastern midlands	Central highlands	Northwestern highlands
Drought tolerance	3*	4*	12	7
High nutritive value	16	2	-	-
High milk yield	5	1	-	1
Palatability	6	3	-	4
High herbage yield	7*	14*	1*	5*
Vigorous growth	8*	-	-	-
Fast re-growth after cutting	4	-	-	-
Large leaves	13*	-	-	-
Shade tolerant	14	-	-	-
Succulent plants	9	-	-	-
Soft forage	10*	-	-	-
Less hairy	1*	-	2*	9*
Firm anchorage of plants in soil	11	-	-	-
High number of tillers	2*	-	-	-
High quality of milk (high butter fat content))	12	-	-	-
Ground cover (Erosion control)	-†	6*	5*	-
Pest tolerant	-	7	4*	6*
Disease tolerant	-	5*	-	-
Easy to establish	-	13*	-	-
Easy to manage	-	12	-	-
Good persistence	15	9	-	2
Growth habit	-	11*	-	-
Tall grass	-	8*	3*	14*
Suitable for cut-and-carry	-	10*	-	10
Green colour	17*	15*	8	-
Frost tolerant	-	-	7	-
Easy to store	-	-	10	-
Withstand water logging	-	-	9	12
Improves soil fertility	-	-	6	3
Wide soil adaptability	-	-	-	8
Smell	-	-	11	-
Can be intercropped with other crops	-	-	-	11
Fast maturity	-	-	-	13*

†Not listed for selection, 1 = most important, 17 = least important
*Phenotypic traits considered by farmers during selection

Table 2. Farmers' scores for grass cultivars averaged over selected phenotypic traits

Grass cultivar	Coastal lowlands	Eastern midlands	Central highlands	Northwestern highlands	Mean score
U. decumbens cv. Basilisk	2.5^{d}	2.9^{ab}	3.5^{bc}	2.9^{a}	3.0
U. humidicola cv. Llanero	2.6^{cd}	2.0^{e}	2.5^{de}	1.7^{d}	2.2
U. brizantha cv. Marandu	3.0^{ab}	2.1^{e}	3.1^{cd}	2.4^{c}	2.7
U. brizantha cv. MG4	2.5^{d}	3.1^{a}	3.6^{bc}	3.1^{a}	3.1
U. hybrid cv. Mulato II	3.2^{a}	2.6^{bcd}	2.5^{de}	1.7^{d}	2.5
U. brizantha cv. Piata	2.9^{bc}	2.4^{d}	3.5^{bc}	2.9^{ab}	2.9
U. brizantha cv. Xaraes	3.1^{ab}	2.5^{cd}	3.3^{c}	2.6^{bc}	2.9
U. humidicola cv. Humidicola	-†	-	2.4^{e}	-	2.4
Napier grass	3.0^{ab}	-	4.1^{ab}	3.0^{a}	3.4
Rhodes grass	2.1^{e}	2.7^{bc}	4.3^{a}	2.3^{c}	2.9
LSD (P < 0.05)	0.23	0.30	0.63	0.35	

Means with different superscripts within columns are significantly different at P<0.05
†Plants established poorly or died and was not evaluated

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