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Research Application Summary

Influence of forage value on the choice of grass species to combat desertification in semi-arid regions of Kenya

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Abstract

Livestock production is the main source of livelihood in the arid and semi-arid lands of Africa. Desertification characterized by vegetation degradation and soil erosion have become major threats to the sustainability of this land-based production system. Native rangeland forage species *Cenchrus ciliaris* L. (Buffel grass/African foxtail grass), *Eragrostis superba* Peyr. (Maasai love grass) and *Enteropogon macrostachyus* (Hochst. Ex A. Rich.) Monro ex Benth. (Bush rye grass) have been used to combat desertification. The objectives of the study were to identify the best suited grass species to combat desertification in a semi-arid environment in Kenya and to identify the preferred grass species among the agropastoralists in the area. Percentage basal cover, plant densities and frequencies of the three grasses in pure stands and mixtures were estimated. Grass species preferences were established through household survey and focus group discussion. Results showed a significant difference (P <0.05) in plant densities and cover estimates: *E. macrostachyus* was ranked first; *C. ciliaris* and *E. superba* were ranked second and third, respectively. However, results from the household surveys and focus group discussions revealed that the agropastoral farmers preferred *E. superba* followed by *C. ciliaris* and *E. macrostachyus*, respectively. They cited increased milk yields from livestock feed on *E. superba* compared to the other grass species. These results suggest that the choice of grass species to combat desertification is influenced more by its contribution as a source of forage for livestock than its contribution for rehabilitation purposes.

Key words: *Cenchrus ciliaris*, *Enteropogon macrostachyus*, *Eragrostis superba*, Kenya, land degradation, rehabilitation

Résumé

La production animale est la principale source de subsistance dans les zones arides et semi-arides de l'Afrique. La désertification caractérisée par la dégradation de la végétation et l'érosion des sols est devenue une menace majeure pour la durabilité de ce système agraire. Les espèces endogènes des parcours fourragères *Cenchrus ciliaris* L., *Eragrostis superba* Peyr, et *Enteropogon macrostachyus* ont été utilisées pour lutter contre la désertification. Les objectifs de l'étude étaient d'identifier les meilleures espèces de graminées adaptées pour lutter contre la désertification dans un environnement semi-aride du Kenya et de déterminer les espèces de graminées les plus préférées des agropasteurs de la région. Le pourcentage de couverture de base, les densités de plantes et les fréquences des trois graminées dans les peuplements purs et mixtes ont été estimés. Les préférences des espèces de graminées ont été établies par une enquête auprès des ménages et des discussions de groupe. Les résultats ont montré une différence significative ($P < 0,05$) dans les densités de plantes et les estimations de couverture: *E. macrostachyus* a été classée premier; tandis que *C. ciliaris* et *E. superba* ont été respectivement classés deuxième et troisième. Cependant, les résultats des enquêtes auprès des ménages et des discussions de groupes ont révélé que les agriculteurs agropastorales préfèrent *E. superba* suivie respectivement de *C. ciliaris* et *E. macrostachyus*. Ils ont cité une augmentation de la production de lait du bétail soumit à un régime de *E. superba* contrairement aux deux autres espèces de graminées. Ces résultats suggèrent que le choix des espèces de graminées dans la lutte contre la désertification est plus influencé par leurs contributions en tant que source de fourrage pour le bétail que leurs utilisations à des fins de réadaptation.

Mots clés: *Cenchrus ciliaris*, *Enteropogon macrostachyus*, *Eragrostis superba*, Kenya, dégradation des terres, réhabilitation

Background

Rangeland degradation is a serious problem in semi-arid Africa (Kinyua *et al.,* 2010). This is because it is causing a major ecological transformation of savannah ecosystems grazed by livestock. Although degradation occurs under a wide variety of conditions and environments, the arid and semi-arid rangelands are more at risk (Mganga *et al.,* 2015a). The decline of productivity, the loss of biodiversity and the increasing rate of soil erosion are degradation's evidence in these environments (Visser *et al.,* 2007). The interaction of heavy grazing and climatic variability can cause dramatic ecological degradation in the semi-arid rangelands (Wessels *et al.,* 2007).

Heavy grazing initially alters vegetation composition and decreases primary productivity, especially of palatable species, thus decreasing the community resilience (Kinyua *et al.,* 2010). Reduced vegetation cover can lead to increased runoff and erosion, which in turn can lead to reduced water availability, nutrient retention and plant establishment. Despite the extensive research on the causes and consequences of rangeland degradation, studies on rangeland restoration are less common (King and Hobbs, 2006). In East Africa, rangeland

degradation is serious and pervasive, but investigations of rangeland restoration have been especially rare.

Considering the enormous extension of the semi-arid rangelands, their ecological and economic value to the pastoral and agropastoral communities in Kenya, it is obvious that improved management methods of rangeland resources are urgently needed. Reseeding is one alternative used to restore ecosystem functionality and productivity despite it being costly and often uncertain (Coronado *et al.,* 2005). Six grass species have been used successfully in reseeding and include: *Cenchrus ciliaris, Chloris gayana, Enteropogon macrostachyus, Eragrostis superba, Cynodon dactylon* and *Chloris roxburghiana.* Grasses selected for this study are *Cenchrus ciliaris, Enteropogon macrostachyus* and *Eragrostis superba*. These perennial grasses have evolved adaptive mechanisms for survival and are thus preferable to all other plants, except in eco-climatic zone VI where the rainfall is mostly too low to support perennials (Mganga *et al.,* 2010). Therefore, the objectives of this study were to identify: (i) the best suited grass species to combat desertification in a semi-arid environment in Kenya, and (ii) the preferred grass species among the agropastoralists in a semi-arid environment in Kenya.

Study description

This study was conducted in semi-arid Makueni County, southeastern Kenya. The average annual rainfall, evaporation and temperatures are 600, 2000mm and 23 °C, respectively (Mwang'ombe *et al.,* 2011). Soils are mainly Ferralsols, Cambisols and Luvisols characterized by strong surface sealing properties that cause much runoff during heavy rains (Mganga *et al.,* 2010). The three grasses *C. ciliaris* (CC), *E. superba* (ES) and *E. macrostachyus* (EM) were sown as pure stands (CC, ES and EM) and as mixtures (CC/EM, CC/ES and ES/EM). The percentage basal cover was estimated using the step-point method (Evans and Love, 1957). Plant densities (plants per m^{-2}) and frequencies were estimated using the quadrat method (Cox, 1990). Household survey and focus group discussion (FGD) were also conducted to establish the preferred grass species for rehabilitation programs.

Results

Plant densities and plant cover estimates varied significantly ($P < 0.05$) between treatments. Overall, *E. macrostachyus* provided the best basal cover; *C. ciliaris* and *E. superba* ranked second and third, respectively (Table 1). However, despite demonstrating the least rehabilitation success, results from the household survey and focus group discussions indicating that *E. superba* was the most preferred species among the agropastoral community. Comparatively, *C. ciliaris* and *E. macrostachyus* were ranked second and third, respectively.

Discussion

Seed size, as a characteristic of seed quality, influences seedling emergence, growth, establishment and vigour. Higher vigour in larger seeds is due to the larger food reserves in these seeds. There is also a positive linear relationship between seed weight and emergence

Table 1. Percent basal cover, frequency and plant density

Experimental plots	Basal cover (%)	Frequency (%)	Plant densities
CC	30c	44a	7a
EM	54ab	72a	36b
ES	23c	40a	5a
CC/EM	34bc	39a	28b
CC/ES	33bc	39a	6a
EM/ES	58a	56a	34b

CC- *Cenchrus ciliaris*, EM- *Enteropogon macrostachyus*, ES- *Eragrostis superba*
Column means followed by different letters are significantly different at $p< 0.05$ as determined by Tukey's B – mean separation

in the field. This contributed significantly to better rehabilitation success under *E. macrostachyus*. Moreover, the dormancy mechanism of *E. macrostachyus* only involves the integument thus its rapid imbibitions and germination compared to *C. ciliaris* and *E. superba*. Faster germination of *E. macrostachyus* also gave it a head start in the normal plant competition. Larger seeds produce seedlings with greater early growth and increased competitive ability against weeds (Mganga *et al.,* 2015b). Preference for *E. superba* by the agropastoral community in the area is attributed to its contribution to livestock production. Wasonga *et al.* (2003) also reported that the Pokots have identified *E. superba* as one of the grass species suitable for fattening and improving milk production.

Conclusion

The choice of grass for rehabilitation programs to combat desertification is much more influenced by their forage value for livestock than their contribution for rehabilitation purposes. Maximising the contribution of *E. macrostachyus* and *E. superba* in mixtures is a feasible method which can be explored further and promoted among pastoral communities in arid and semi-arid environments.

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