Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol.11, pp.001-005, December, 2010

ISSN: 0975-833X

RESEARCH ARTICLE

THE CHALLENGES POSED BY *Ipomoea kituensis* AND THE GRASS-WEED INTERACTION IN A RESEEDED SEMI-ARID ENVIRONMENT IN KENYA

Kevin Z. Mganga*,[1]Nashon K.R. Musimba,[1]Dickson M. Nyariki,[1]Moses M. Nyangito,[2]Agnes, W. Mwang'ombe[3] , Wellington N. Ekaya[4] and William M. Muiru[3]

[1]Department of Range & Wildlife Sciences, South Eastern University College (SEUCO), P.O. BOX 170-90200, Kitui, Kenya
[2]Department of Land Resource Management & Agricultural Technology, University of Nairobi
[3]Department of Plant & Crop Sciences, University of Nairobi, P.O. BOX 29053-00625, Nairobi, Kenya
[4]RUFORUM, P.O. BOX 7062, Kampala, Uganda

ARTICLE INFO

Article History:
Received 5th September, 2010
Received in revised form
7th October, 2010
Accepted 24th October, 2010
Published online 4th December, 2010

Key words:
Rehabilitation,
Ipomoea kituensis,
Grass-Weed Interaction,
Inverse Relationship.

ABSTRACT

Rehabilitation of denuded patches using perennial grasses has been used extensively in semi-arid environments of Kenya. However, weeds continue to pose an enormous challenge to the success of many rehabilitation programmes. The aim of this study was to identify the common weeds that pose a challenge to rehabilitation success and establish the grass-weed interactions in rehabilitated areas of a semi-arid environment in Kenya. A survey questionnaire was administered to capture the farmers' perception on the most problematic weeds and the challenge they pose to rehabilitation programmes. Experimental plots were laid out under simulated rainfall (sprinkler system). Three perennial grasses; *Cenchrus ciliaris, Eragrostis superba,* and *Enteropogon macrostachyus,* were used. These grasses were sown along ox-ploughed micro-catchments as pure stands and two grass mixtures and monitored at three phenological stages; early vegetative (15cm), elongation (30cm) and reproduction (60cm) representing high, medium and low grazing intensities respectively. Results from this survey showed *Ipomoea kituensis* posed the greatest challenge to rehabilitation programmes. Results also showed an inverse relationship in biomass yields between the weeds and established grasses across the three phenological stages. These results strongly suggest that selective weeding of rehabilitated semi-arid environments is critical for the success of rehabilitation programmes in semi-arid Kenya.

© Copy Right, IJCR, 2010 Academic Journals. All rights reserved.

INTRODUCTION

Degradation of vegetation cover and soil is a common problem in semi-arid lands in Kenya. Although land degradation occurs under a wide

***Corresponding author:** Kevin Z. Mganga, Department of Range & Wildl*
P.O. BOX 170-90200, Kitui, KENYA. E.M

variety of conditions and environments, some are more at risk of degradation, especially the arid and semi-arid lands (ASALs). This is because the soils have poor soil structure as a result of low levels of organic matter (Mganga *et al.,* 2010a). 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). Taking into consideration the enormous extension of the semi-arid rangelands, their ecological and economical value and their importance for the agro-pastoral communities in this environment, it is obvious that improved management methods of rangeland resources are urgently needed. Reseeding is one alternative used to restore ecosystem functionality and productivity in these contexts though it is costly and often uncertain (Coronado *et al.,* 2005). It is therefore important to understand the behaviour of plants used for reseeding in different ecosystems (Smith *et al.,* 2000).

Sufficient moisture is the most limiting factor in rehabilitation programmes in semi-arid lands of Kenya (Mganga *et al.,* 2010a). This can be attributed to the hot, dry conditions and short rainy periods that dry the soil surface, reducing germination percentage and rate and quickly and dramatically altering the physical and biological environment of plant roots (Coronado *et al.,* 2005). However, when moisture is not limiting, other factors such as soil type, inappropriate sowing methods, poor seed bed preparation and poor timing, use of poor quality seed can all contribute to rehabilitation failures. Weeds also pose a great challenge to rehabilitation programmes as they compete with the sown grasses for the available soil nutrients and limited soil moisture in the semi-arid environment. Weed species can be very aggressive thus colonize wide areas within a very short time after the onset of the rains. The objective of this study was to establish the grass-weed interaction in a rehabilitated semi-arid environment in Kenya and identify the most problematic weed species which contribute to rehabilitation failure in the study area.

MATERIALS AND METHODS

Study area

The study was conducted in the semi-arid district of Kibwezi, south-eastern Kenya. The district lies between latitudes 2º 6′S and 3ºS, and longitude 37º 36′E and 38º 30′E respectively (Mganga *et al.,* 2010b). The district has a total area of 3400 km² (CBS, 2000). The agropastoral Kamba community is the predominant ethnic group in the district (Nyangito *et al.,* 2008; Mganga *et al.,* 2010b). Their main source of livelihood is raising of local livestock breeds mainly the small east African Shorthorn Zebu cattle, red Maasai sheep and the small east African goat and growing different varieties of drought tolerant maize, millet, beans, sorghum and pigeon peas (Nyangito *et al.,* 2009).

The climate is typical semi-arid and the district characterized by low and unreliable supply of enough moisture for plant growth. The average annual rainfall, evaporation and temperatures are 600mm, 2000mm and 23°C respectively (Musimba *et al.,* 2004). The most soils are considered problematic because their physico-chemical properties limit the uses for agricultural purposes (Biamah, 2005). They generally have low organic matter contents and an unstable structure (Mganga et al., 2010c). The main problems associated with the soils are high levels of salinity and sodicity, poor drainage, soil erosion, soil compaction, soil crusting and low soil fertility (Biamah *et al.,* 1994). Such soils are generally very vulnerable to physical erosion and chemical and biological degradation (El Beltagy, 2002). The natural vegetation is woodland and savanna with several tree species, mainly *Acacia* species (A) such as *Acacia tortilis* (Forsk) and *Acacia mellifera* (Vahl) Benth, *Commiphora africana* (A. Rich), *Adansonia digitata* Linn and *Tamarindus indica* L. Shrubs include *Grewia* species (Nyangito *et al.,* 2009). The common perennial grasses include *Cenchrus ciliaris, Eragrostis superba, Chloris roxburghiana* and *Enteropogon macrostachyus* (Musimba *et al.,* 2004).

Land preparation and experimental design

Land preparation involved creation of shallow microcatchments of a depth of 15cm using an ox-driven plough and fencing of the site using locally available *Acacia* branches to keep-off free grazing livestock. The experimental design was a Complete

each other. The main plots were separated from each other with a 5m fire break. The three main plots were further sub-divided into six (6) sub-plots each measuring 5 X 5m. The grass seeds were hand sown along the micro-catchments as pure stands (*Cenchrus ciliaris, Enteropogon macrostachyus* and *Eragrostis superba*) and as two grass mixtures (*C. ciliaris – E. superba, C. ciliaris – E. macrostachyus, E. superba – E. macrostachyus*) in each sub-plot. The experimental plots were put under simulated rainfall (sprinkler irrigation). The sprinkler irrigation system application rate was $0.638 cm^3 sec^{-1}$.

Sampling biomass production

Biomass production in all the sub-plots in every plot was estimated using the quadrat method. Destructive sampling technique of clipping within a $0.25m^2$ size quadrat was used. Clipping was done at a stubble height of 2.5cm. Six (6) quadrats were placed at each sub-plot. The harvested biomass for the grasses and weeds in each sampling quadrat were placed in separate sealed brown paper bags, labelled and oven dried at 80°C for 96 hours to remove the moisture and weighed to estimate dry matter yields (kg/ha). Biomass was collected at heights of 15cm (early growth stage), 30cm (elongation stage) and 60cm (reproduction).

Data collection and analyses

Dry matter yields of the grasses and the weeds were compared using One-Way Analysis of Variance and the means separated using Turkey's-b. Mean separation was done at $p < 0.05$. SPSS (Einstein and Abernethy, 2000) was used to analyze the data. A household survey was conducted among 50 agro-pastoralists using semi-structured questionnaires. Questions were dichotomous, multi-choice and open ended to allow ease of capture of the diverse issues on the common weeds in rehabilitated denuded semi-arid lands.

RESULTS AND DISCUSSION

at different heights among the grasses and weeds.

The inverse relationship between biomass yields of planted grasses and weeds is shown in Tables 1 and 2 below.

Table 1. Biomass yields on dry matter basis (Kg/ha) at different stubble heights

Plot	Biomass Kg/ha (DM)					
	15cm		30cm		60cm	
	Grass	Weeds	Grass	Weeds	Grass	Weeds
CC	44.2^{a}	360.8^{d}	104.2^{a}	85.56^{c}	1026.6^{b}	37.16^{c}
EM	83.9^{a}	662.4^{d}	168.0^{a}	70.04^{c}	744.0^{b}	52.92^{c}
ES	47.0^{a}	386.4^{d}	109.8^{a}	66.36^{c}	896.5^{b}	58.60^{c}
CC/EM	32.0^{a}	308.4^{d}	144.0^{a}	63.12^{c}	780.9^{b}	49.72^{c}
CC/ES	43.4^{a}	309.5^{d}	169.2^{a}	71.16^{c}	808.3^{b}	39.64^{c}
EM/ES	59.0^{a}	398.8^{d}	164.8^{a}	62.36^{c}	709.3^{b}	53.04^{c}

Notes: CC- *Cenchrus ciliaris*, EM- *Enteropogon macrostachyus*, ES- *Eragrostis superb;* Row means with different superscripts (a, b) are significantly different at p< 0.05; Row means with different superscripts (c, d) are significantly different at p< 0.05

Table 2. Percentages of the total biomass yield of the grasses and weeds at different heights

Plot	Percentage (%)					
	15cm		30cm		60cm	
	Grass	Weeds	Grass	Weeds	Grass	Weeds
CC	11%	89%	55%	45%	96%	4%
EM	11%	89%	71%	29%	93%	7%
ES	6%	94%	62%	38%	94%	6%
CC/EM	9%	91%	70%	30%	94%	6%
CC/ES	12%	88%	70%	30%	95%	5%
EM/ES	16%	84%	73%	27%	93%	7%

Notes: CC- *Cenchrus ciliaris*, EM- *Enteropogon macrostachyus*, ES- *Eragrostis superba*

Table 3. Ranking of the common weeds in rehabilitated semi-arid lands of south-eastern Kenya

Species of weeds	Frequency of correspondence	Ranking
Ipomoea kituensis	100%	1
Ocimum species	38%	6
Aconthospernum hispidum	82%	2
Commelina bengalensis	60%	3
Oxygonum sinuatum	58%	3
Lactuca capensis	40%	5
Datura stramonium	38%	6
Digitaria scalarum	16%	9
Cynodon dactylon	24%	8

The inverse relationship in biomass yields between the sown grasses and the weeds can be explained by the longevity of the grasses and the weeds. The common weeds identified in the

from the survey showed that *Ipomoea kituensis* was

stages of development. However, the perennial grasses out-competed the weeds at the later stages. *Cenchrus ciliaris* showed the highest competitive advantage over the weeds by limiting their establishment in the plots. *Eragrostis superba* and *Enteropogon macrostachyus* demonstrate almost identical competitive advantage over the weeds at the reproductive stage (60cm). However, *Eragrostis superba* showed a higher competitive advantage than *Enteropogon macrostachyus* at the early (15cm) and elongation (30cm) stages. The competitive advantage of *Cenchrus ciliaris* can be attributed to its deep strong fibrous system. It is a particularly aggressive grass, by virtue of its extensive root system competing with associated species for water and nutrients. It also appears to be allelopathic (suppression of other species by exudation of phytotoxic chemicals that inhibit germination and growth of other plants) (Mganga, 2009). Results from this study also showed that two grass mixtures with *Cenchrus ciliaris* also suppressed the weeds. This can be attributed to the presence of *Cenchrus ciliaris* in the grass mixture. *Eragrostis superba* roots are limited to the upper 0.4m from the soil surface. This enables the grass to make full use of light showers of rain (Opiyo, 2007). This explains its competitive advantage over weeds compared to *Enteropogon macrostachyus*.

Results from the survey showed *Ipomoea kituensis* to be the most problematic and commonest weed affecting rehabilitated semi-arid lands in the study area. *Ipomoea kituensis* is a creeping annual herb which colonizes and spreads rapidly immediately after the onset of the rainy season. It is widespread in the semi-arid districts in Kenya. The weed was noted to be the most problematic in the study area since it engulfs and covers the newly established grass stand. This deprives the grasses enough sunlight for photosynthesis. Additionally, the fresh and heavy biomass of *Ipomoea kituensis* also suppresses the growth and development of the grasses underneath it resulting to high incidences of seedling mortality. This consequently results to poor establishment and much of the denuded areas remain bare after disappearance weed at the end of the rains. Results the common weeds hampering rehabilitation efforts in the area.

Conclusion

There exists an inverse relationship between sown perennial grasses and weeds in rehabilitated plots over a period of time. Weed biomass is predominant in the early stages of establishment compared to the sown grasses. However, at the end reproductive stage, grass biomass becomes more predominant out-competing the weeds. *Ipomoea kituensis* is the most problematic weed species in the semi-arid environment in south-eastern Kenya which results to rehabilitation failures using grass reseeding technology.

Acknowledgement

We gratefully acknowledge the Agricultural Innovations for Drylands Africa (AIDA) (Grant Number 043863-SSA Africa-2006) for the financial support for this research. The opportunity to use the University of Nairobi facilities both in Nairobi and Kibwezi Field Station is also highly appreciated. We would also like to thank the Kamba agropastoral community in Kibwezi district, Kenya for their active participation and sharing their indigenous technical knowledge during the study period.

REFERENCES

Biamah, E.K. 2005. Coping with drought: Options for soil and water management in semi-arid Kenya. Tropical Resource Management Papers, No. 58. Wageningen University and Research Centre (Wageningen UR).

Biamah E.K., Nagaya L.M., Gichangi E.M. and Cherogony R.K.K. 1994. Microscale effects of tillage and organic manure on infiltration and erosion of a crusting soil. 1: 387-405. In: Jensen HE, Schjonning P, Mikkelsen SA, Madsen KB (Eds). Soil tillage for crop production and protection of the environment, Proceedings of the 13th International Soil Tillage Research Conference, July, 1994, Aalborg, Denmark.

Development, Nairobi.

Coronado, M.H.E. Castillo, A.M., Cerecedo, M.S., Romo, R.C. and Castro, J.J. 2005. Emergence and survival of native and introduced grasses in an arid environment under different wet-dry sequences in three soil types. *Téc. Pecu. Méc.,* 43(1): 101-115.

Einstein, G. and Abernethy, K. 2000. Statistical package for the social sciences (SPSS) Version 12.0. Furman University.

El Beltagy, A. 2002. ICARDA' Experience in the Rehabilitation of Degraded Drylands of Central and Western Asia and Northern Africa: In the proceedings of the International Workshop on Combating Desertification. Rehabilitation of Degraded Dry lands and Biosphere Reserves, Aleppo, Syria, May 2-3, 2002.

Mganga, K.Z., Musimba, N.K.R., Nyangito, M.M., Nyariki, D.M., Mwang'ombe, A.W., Ekaya, W.N., Muiru, W.M., Clavel, D., Francis, J., Kaufmann, R. and Verhagen, J. 2010a. The role of moisture in the successful rehabilitation of denuded patches of a semi-arid environment in Kenya. *J. of Environ. Sci. Tech.,* 3(4): 195-.207

Mganga, K.Z., Musimba, N.K.R., Nyariki, D.M., Nyangito, M.M., Mwang'ombe, A.W., Ekaya, W.N., Clavel, D., Francis, J., Kaufmann, R., Verhagen, J. and Muiru, W.M. 2010b. Dry matter yields and hydrological properties of three perennial grasses of a semi-arid environment in east Africa. *Afr. J. of Plant Sci.,* 4(5): 138-144.

Mganga, K.Z., Musimba, N.K.R., Nyariki, D.M., Nyangito, M.M. and Mwang'ombe, A.W. 2010c. Improving hydrological responses of degraded soils in semi-arid Kenya. *J. of Environ. Sci. Tech*., 3(4): 217-225.

Mganga, K.Z. 2009. Impact of grass reseeding technology on rehabilitation of the degraded rangelands: a case study of Kibwezi district, Kenya. MSc Thesis, University of Nairobi, Nairobi, Kenya.

Musimba, N.K.R., Nyariki, D.M., Ikutwa, C.N. and Teka, T. 2004. Dryland Husbandry for sustainable development in the southern rangelands of Kenya. OSSREA, Addis Ababa, 2004.

Nyangito, M.M., Musimba, N.K.R. and Nyariki, D.M. 2008. Range use and dynamics in the agropastoral system of southeastern Kenya. *Afr. J. of Environ. Sci. Tech.,* 2(8): 220-230.

Nyangito, M.M., Musimba, N.K.R. and Nyariki, D.M. 2009. Hydrological properties of grazed perennial swards in semiarid southeastern Kenya. *Afr. J. of Environ. Sci. Tech.,* 3(2): 026-033.

Opiyo, F.O. 2007. Land treatment effects on morphometric characteristics of three grass species and economic returns from reseeding in Kitui district, Kenya. MSc Thesis, University of Nairobi, Nairobi, Kenya.

Smith, S.E., Riley, E., Tiss, J.L. and Ferdenheim, D. 2000. Geographical variations in predictive seeding emergence in a perennial desert grass. *J. Ecol.,* 88:139-149.

Visser, N., Morris, C., Hardy, M.B. and Botha, J.C. 2007. Restoring bare patches in the Nama-Karoo of South Africa. *Afr. J. of Range and Forage Sci.,* 24(2):87-96.

****