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Performance of improved range grasses and tropical legumes in the Southern Rangelands of Kenya

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ABSTRACT:
Sixty per cent of the IGAD landmass is arid and semi-arid. In Kenya the semi-arid and arid (ASAL) make-up 80% of the land mass. Over 60% of the livestock in the region are found in the ASAL areas and contribute between 10-50% of the GDP of individual countries in the region. The ASAL areas are faced with a myriad of challenges including climate change, livestock forage availability and environmental degradation. During the last drought Kenya lost 2.1 million animals valued at USD 406,153 (KES 52.8 Million). The frequent droughts and reduced productivity of rangelands threaten the sustainability of the livestock sector in the region. The lack of year-round adequate quantity and quality feed supply results in low weight gain and milk production and high greenhouse gas emission per unit of livestock product. To address the challenge of feed quality and quantity, the performance of improved range grass varieties (*Megathrysus maximus* variety Siambasa and *Cenchrus ciliaris*) were evaluated as sole crops or intercropped with *Clitoria ternatea* or *Macroptilium atropurpureum*) at the KALRO centre in Kiboko Eastern Kenya. The experiment was an RCBD with treatments in a 2x3 factorial arrangement. Dry matter yield, proportion of grass/ legume, chemical composition, digestibility and in-vitro fermentation were determined. The DM yield ranged from 3.3 to 5.8 tonnes/ha with the highest in *M. maximus* mixtures and the lowest in *C. ciliaris* plots. The proportion of legume in the mixtures ranged from 84-20% with the highest levels in the *C. ciliaris* mixtures. The improved range grass varieties have the potential to increase forage availability.

Introduction

Approximately 62.9 million people in the IGAD region of East Africa are currently experiencing acute food insecurity (IGAD 2024). This is approximately 25% of the entire population of the region. About 60% of the region is classified as arid and semi-arid rangelands and livestock play a key role in food security. In the semi-arid areas of IGAD, livestock provides food, income and employment for millions of livestock farmers and pastoralist's communities in the region. Export of livestock and livestock products are a significant export from the region earning foreign exchange that is seriously required in the region. The livestock sub-sector contributes between 10-50% of the GDP of individual countries in the region. In Kenya, the semi-arid lands (SAL) make-up 80% of the land mass and are home to approximately 25% of the human population. These areas face persistent for insecurity

a situation that is made worse by climate change. The semi-arid areas of Kenya are home to over 60% of the livestock (cattle, sheep, goats and camels) and over 70% of the wildlife (Odero-Waitituh 2017). Livestock production is the major economic activity in these areas and is key to food security, income and employment.

However, livestock production is constrained by a number of factors including; inadequate feed quantity and quality, low yielding breeds, poor animal health services, poor market infrastructure and environmental degradation among others. This has been made worse by climate change where we have more frequent severe climatic events including droughts and floods. During the last drought Kenya lost 2.1 million animals valued at USD 406,153 (KES 52.8 Million). The frequent droughts and reduced productivity of rangelands threaten the sustainability of the livestock sector in the region. Beef cattle grazing is a key enterprise in the Semi-arid areas, however poor quality and inadequate feeds especially during the dry season. Incorporating legumes into pastures improve the cattle diet and this study aims to evaluate the productivity of mixed range grasses and tropical legumes in the semi-arid areas of Kenya.

Methods

The study was carried out at the Kenya Agricultural and Livestock Research Centre in Kiboko, Eastern Kenya. Land was prepared and divided into 5 blocks with 8 plots of 5 x5 m. The treatments included two range grasses; *Megathrysus maximus* variety Siambasa and *Cenchrus ciliaris* and two tropical legumes *Clitoria ternatea* and *Macroptilium atropurpureum.* The experiment was established during the OND 2022 rain season. The grass and legumes were grown as sole crops or as mixed crops. The experiment was an RCBD with treatments in a 2x2 factorial arrangement. Four harvests were taking starting in April to November 2023. Proximate analysis was performed using standard AOAC methods (2006)> Fibre fractions were determined using the detergent fraction method (Van Soest, 1967). Dry matter yield, proportion of grass/ legume, chemical composition, digestibility and in-vitro fermentation were determined.

Results

Forage Yield

The DM yield ranged from 3.3 to 5.8 tonnes/ha with the highest in *M. maximus* mixtures and the lowest in *C. ciliaris* plots. The proportion of legume in the mixtures ranged from 84-20% with the highest levels in the *C. ciliaris* mixtures. The improved range grass varieties have the potential to increase forage availability.

M. maximus var Siambasa as a sole crop had a signifactly higher yield *(P<0.001)* than *C. ciliaris* (Figure 1). *C. ternatea* had a significantly higher *(P<0.03)* dry matter yield than M. atropurpureum (Figure 1). The M. maximus intercropped with *C. ternatea* and *M. atropurpureum* had lower dry matter yield than *M. maximus* sole crop.

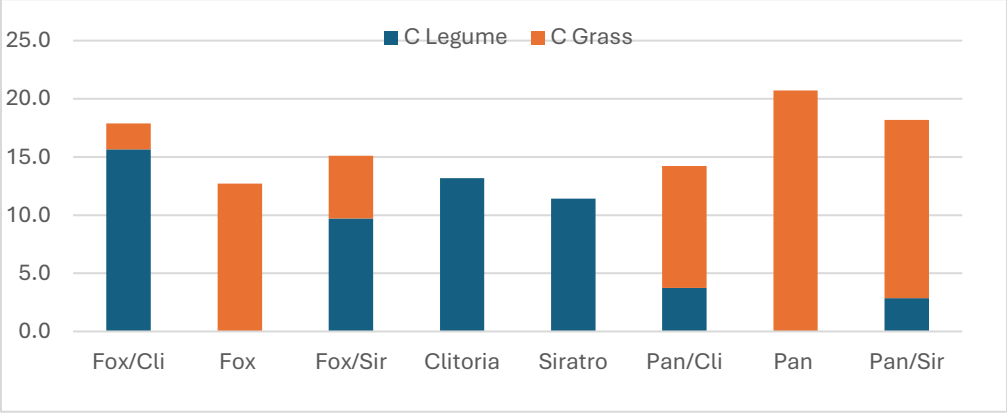

Figure 1: Forage Dry Matter Yield of Range Grasses and Tropical Legumes (t/ha)

The crude protein yield for the grass/ legume mixture ranged from 1.2 to 2.6 tons/ha/year (Table 1). The inclusion of legume increased the total crude protein yield especially when grown with *C. ciliaris*. However, the total crude protein yield was lower in both the *M. maximus* legume mixtures (Table 1).

Table 1: Crude Protein Yield for Range Grass and Legume Mixtures in Kiboko, Kenya (kg/h)

	C. ciliaris/Clitoria	*C. ciliaris*	*C. ciliaris/ siratro*	*Clitoria*	*Siratro*	*M. maximus/Clitoria*	*M. maximus*	*M. maximus/Siratro*
Grass	2176.0	1232.9	523.8	0	0	1143.6	2259.3	1671.9
Legume	30.8	0	1553.6	2597.4	1825.6	737.7	0	45.6
Total	2206.8	1232.9	2077.4	2597.4	1825.6	1881.5	2259.3	1717.5

Digestibility

Dry matter digestibility was lowest in the C. ciliaris and *M. atropurpureum*. The other mixture ha similar dry matter digestibility which ranged from 52.5 – 54% (Table 2). Organic matter digestibility was higher in the mixtures with *M. maximus* and much lower in the mixtures with *C. ciliaris* (Table 2).

Table 2: Digestibility Coefficients of Mixed Grass and Legume diets

Feed Mixer Type	DMD%	*OMD%*	*DoMD (g/Kg DM)*
C. ciliaris/Clitoria	54.0	57.1	503.0
C. ciliaris/Siratro	43.0	48.1	541.4
M. Maximus/Clitoria	52.5	54.5	466.9
M. maximus/Siratro	53.7	64.1	456.4

Discussion

Legume and grass mixtures have the potential to improve soil health and livestock production. In the ASAL areas of Kenya feed quality and especially the low digestibility and crude protein content of the local grasses limits livestock production. Legumes have a higher crude protein, energy and mineral content than tropical grasses and can be used to address the N deficit in tropical grasses. However, the selection of grasses and legumes to grow in a mixture will determine the success integrating legumes into grass pastures. Recently a number of grass varieties have been introduced in the semi-arid areas of Kenya and this experiment evaluated the compatibility of the tropical legumes and two of the grass varieties. The two legumes used reduced the *C. ciliaris* yield from 12 to only about 5 tons/ha per year. This reduction was highest in the early stages of establishment and although the proportion improved in later harvests the total yield was still very low. However, the two legumes seem to compensate for the low grass yield and there was no difference in the yield per year between the legume/grass mixtures and the grass sole crop. However, the crude protein yield was higher than that of the sole *C. ciliaris* crop. Sole *M. maximus* produced much higher yield than the grass legume mixture which could have been an indication of competition for water and minerals between the legumes and this tall tufted grass. The sole M. maximus crop had a higher crude protein content than the legume grass mixtures implying no major advantage of growing the grass in a legume mixture. As the legume proportion seems to increase with time, the trail will be keep for a number of seasons to determine if this finding will change.

Implications of the results

Although intercropping C. ciliaris reduces grass yield significantly the mixtures produce more forage of higher nutritive quality and therefore can be recommended to farmers growing *C. ciliaris*. However, different planting arrangements should be tried to determine whether the competition between the legume and grass can be reduced. More work is required before a decision on which legumes can be intercropped with *M. maximus.*

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