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Yield Potential of Grass-Legume Pastures under Different Management Conditions

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Abstract: The objectives of this study, were to evaluate the survival of herbaceous legumes under frequent harvesting and the productivity of *Pennisetum purpureum* under mulching and intercropping conditions. The study was carried out at Rubona research station in the mid-altitude zone of Rwanda. The herbaceous legumes used in the experiment were *Pueraria phaseoloides*, *Desmodium intortum* and *Sytlosanthes guinensis*. The herbage was harvested at a cutting height and interval/frequency of 10 cm and three months, respectively in both wet and dry seasons. Average yields of the five harvests of *Pueraria phaseoloides*, *Desmodium intortum* and *Sytlosanthes guinensis* were 2.0, 1.65 and 1.24 t DM ha^{-1}, respectively with no significant ($p>0.05$) difference between them. *Sytlosanthes guinensis* could not persist frequent harvesting and therefore disappeared after the 4th harvesting. Mulched plots of *Pennisetum purpureum* gave highly significant ($p<0.001$) cumulative DM yield (25.7 t ha^{-1}) than both intercropped with *Desmodium intortum* (20.4 t ha^{-1}) and the control (15.3 t ha^{-1}) plots. It was concluded that *Desmodium intortum* and *Pueraria phaseoloides* exhibited higher yields and better persistency than *Sytlosanthes guinensis* but their suitability to withstand frequent harvesting under farmers' conditions needs further evaluation. Furthermore, mulching seemed to be important in sustaining production of *Pennisetum purpureum* in cut-and-carry systems.

Key words: Herbaceous legumes, intercropping, mulching, persistence, cutting interval, herbage production

INTRODUCTION

The majority of farmers in Rwanda and other eastern and central African countries use Napier grass (*Pennisetum purpureum*) as the main basal forage for feeding of their dairy cattle. However, lack of awareness among farmers on some agronomical practices which are known to affect the productivity of Napier grass like moisture conservation, fertilizer application and appropriate cutting height (Goldson, 1977) hinders them to maximize Napier production.

Utilization of herbaceous legumes in livestock systems is known to improve fodder productivity. When legumes are mixed with grasses they have the potential to produce high dry matter yield of high quality (Skerman *et al*., 1988). It is however, important to assess the ability of legumes in question to withstand the harvesting practices observed in intensive and semi-intensive cut-and-carry dairy production systems.

Mulching is a beneficial soil management practice that improves soil fertility, soil moisture, crop nourishment and productivity (Stigler, 1984; Ssali *et al*., 2003). However, pasture productivity is a complex function between genotype, environment and the agronomic management practices applied.

In this light, the experiments were initiated at Rubona research station to assess the persistence of some promising legumes to Mid-altitude zone of Rwanda like *Pueraria phaseoloides Desmodium intortum* and *Sytlosanthes guinensis* (Barahenda, 2003) subjected to frequent harvesting and the effect of mulching and intercropping Napier with *Desmodium intortum* on its DM yield.

MATERIALS AND METHODS

Trial 1: Persistence of legumes under frequent harvesting: This trial was conducted at Rubona research station, Huye District, Southern Province, Rwanda which is in the Mid-altitude Zone of the country. The station is situated at latitude 2° 29' S and longitude 29° 41' E at an altitude of about 1650 m.a.s.l. The area normally receives a bimodal rainfall pattern (September to December and March to May) averaging 1100-1300mm per annum; and an average daily temperature of around 20°C. The soils are acidic (pH 4.7-5.3), sandy-clay and generally well drained.

Three herbaceous legumes (*Desmodium intortum*, *Pueraria phaseoloides* and *Stylosanthes guinensis*) suited/recommended to the Mid-altitude zone were

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evaluated for their productivity and survival. After scarification, seeds were drilled in a well prepared seed beds. The plot size was 2.5×5 m with rows spaced 50 cm apart and plots were separated by 1m width. The herbaceous legumes were sown in a Randomized Complete Design (RCD) with three replications. To measure dry matter production, the harvests were taken within a 1×1 m quadrats placed randomly in the middle of each plot at a height of about 10 cm above the ground level. Harvesting interval was every three months between January 2005 and January 2006. During each harvesting, about 200 g of biomass was sampled and oven-dried at 105°C to constant weight to determine dry weights.

Trial 2: Effect of mulching and legume intercropping on yield of Napier: Trial 2 was conducted at the same research station as Trial 1.Treatments involved in this experiment were: Control (Napier without mulch), mulching with giant *Themeda* sp. and intercropping with *Desmodium intortum*. Napier grass (*Pennisetum pupureum*) was established from cuttings where two nodes were buried and the third remained above the ground. The spacing was 1m between and 0.5 m within rows. For intercropped plots, Desmodium seeds were drilled between Napier rows. The plot size was 2.5×5 m. A randomized complete design with three replications was used. Forages were harvested to leave a stump about 10cm above the ground level whenever Napier reached a height of 1 m. During each harvesting fresh weight was recorded where about 200 g was sampled and oven-dried at 105°C to constant weight for estimation of dry matter production.

Data analysis: The mean Dry Matter (DM) yield between treatments was compared using students t-test, at 0.05 level of significance.

RESULTS AND DISCUSSION

Persistence of herbaceous legumes subjected to frequent harvesting: The DM yield (t ha^{-1}) for all three species of herbaceous legumes varied with the month of harvesting (Fig. 1) with peak yield occurring in the April harvest which coincides with the period of maximum precipitation in the study area.

Pueraria phaseoloides gave high yield ranging from as high as 4.1 (second cut) to as low as 0.43 (fifth cut) tDM ha^{-1}. The yield of Desmodium intortum ranged from 0.37 (fifth cut) to 3.3 (second cut) tDM ha^{-1}. *Stylosanthes guinensis* recorded not only relatively low yield (ranging from as low as 0.2 to maximum production of 2.8 t/DM ha^{-1}) but also disappeared after 4th harvest. Average yields of the five harvests of *Pueraria phaseoloides*, *Desmodium intortum* and *Sytlosanthes guinensis* were 2.0, 1.65 and 1.24 t DM ha^{-1}, respectively with no significant ($p>0.05$) difference between them. Such a difference in DM yields of these legumes most likely is due to their varying ability to persist when subjected to a high pressure of harvesting. The disappearance of *Stylosanthes guinensis* after the 4th harvest is probably due to the fact that it is not suited to or can not withstand frequent harvesting.

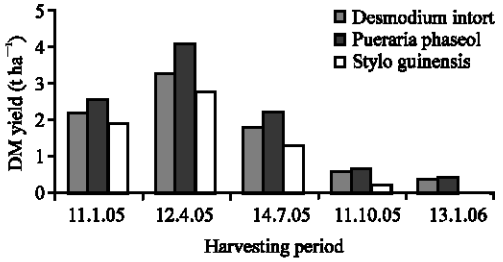

Fig. 1: Persistence of species under frequent harvesting

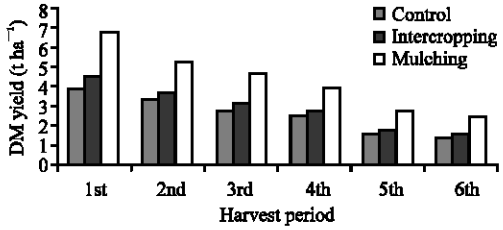

Fig. 2: Effect of mulching and legume intercropping on yield of Napier

Effect of legume intercropping and mulching on the yield of (*Pennisetum purpureum*): As per results in Fig. 2, mulching of Napier grass gave the highest forage yield in each of the six harvests carried out from January 2005 to April 2006. In the plots under intercropping, *Pennisetum purpureum* yielded 17.2 tDM ha^{-1} and *Desmodium intortum* 3.2 tDM ha^{-1} making a total of 20.4 tDM ha^{-1}. Mulched plots of *Pennisetum purpureum* gave highly significant ($p<0.001$) cumulative DM yield (25.7 t ha^{-1}) than both intercropped wih *Desmodium intortum* (20.4 t ha^{-1}) and the control (15.3 t ha^{-1}) plots. The yield response

to mulching in this trial, reflects the importance of moisture on DM yield of Napier (Goldson, 1977). In addition, the application of mulch should have increased organic matter content and lowered temperature and hence high DM yield.

CONCLUSION

Desmodium intortum and *Pueraria phaseoloides* exhibited higher DM yields and better persistency than *Sytlosanthes guinensis* but their suitability to withstand frequent harvesting under smallholder farmers' conditions needs further evaluation. Furthermore, mulching seemed to be important in sustaining production of *Pennisetum purpureum* and should be recommended in cut-and-carry smallholder dairy systems.

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