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INTRODUCTION OF MULTIPURPOSE TREE SPECIES FOR IMPROVING THE PRODUCTIVITY OF GRASSLANDS IN THE TROPICS

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ABSTRACT

To improve the productivity of the Sahelian pastures, 10 different tree species were introduced and cattle, sheep and goats were allowed to graze. After a year of establishment, survival rate of different species ranged from 6% to 68%. *Acacia senegal*, *Acacia seyal*, *Acacia nilotica*, *Combretum aculeata* and *Prosopis cineraria* performed well and the impact of browsing by goats was severe.

KEYWORDS

Sahelian pasture, multipurpose tree species, grazing impact, forage productivity.

INTRODUCTION

Livestock is an important source of livelihood in the Sahel. The salient features of livestock husbandry are management of mixed herd and community ownership of the pastures. The pastures in Senegal are comprised of herbaceous species such as *Schoenefeldia gracilis*, *Ipomea vagans*, *I. coptia*, *Corchorus tridens* and *Merremia pinnata* and woody species like *Acacia senegal*, *Acacia raddiana*, *Balanites aegyptiaca*, *Boscia senegalensis*, *Combretum aculeatum*, *Calatropis procera* and *Grewia bicolor* (Nolon *et al.*, 1994).

With the increasing population pressure during the last 30 years, overgrazing, felling of trees, shifting cultivation and run-off rainwater have increased significantly thereby enhancing deforestation, soil erosion, lowering of water table and reduction in forage yield. Studies in the tropics have indicated that establishment of Multipurpose Tree Species (MPTS) on grasslands can improve the productivity through supply of forage, enrichment of soils and improved micro-climate (Hegde, 1995). However, the major challenge is to establish trees under harsh climate and grazing pressure. Thus the selection of tree species should be based on their tolerance to drought and biotic pressure. With this background, a study was undertaken to improve the productivity of pastures in the Sahelian region of Senegal, through the introduction of different MPTS. The specific objectives are to study the survival of different MPTS, effect of grazing by cattle, sheep and goats on their growth and the impact of trees on forage.

METHODS

The field trial was laid out at the Institute Senegalais De Recherches Agricoles (ISRA) at Dahra in Louga province, in Senegal. The mean annual rainfall at the site is 320 mm, distributed between July and October. The soil is sandy. Considering their adaptability in the native region and elsewhere, the species selected for this trial were *Acacia nilotica*, *Acacia raddiana*, *Acacia senegal*, *Acacia seyal*, *Bauhinia rufescens*, *Combretum aculeata*, *Leucaena leucocephala*, *Parkinsonia aculeata*, *Prosopis cineraria* and *Zizyphus mauritiana*. Seeds of *Acacia nilotica*, *Leucaena leucocephala*, *Parkinsonia aculeata* and *Prosopis cineraria* were sent from India. Four month old seedlings were planted in the pasture in September 1995. The subplot treatments were to allow different species of livestock to graze at 0, 6, 12 and 18 months after planting the seedlings. Periodic observations on the survival, height and collar girth of the plants were recorded. It was too early to observe the impact of different MPTS on forage yield.

RESULTS AND DISCUSSION

Survival: The survival of different species after six weeks of planting ranged from 95 to 100%. Subsequently, there was high mortality (Table 1). During the summer, the highest survival of 73.33% was recorded by *Acacia senegal* followed by *Acacia raddiana* and *Acacia seyal*. Least survival of 16.67% was observed in *Leucaena leucocephala* followed by *Bauhinia rufescens*. With further grazing, some species suffered greater mortality. However, some stumps of *Acacia nilotica*, *Bauhinia rufescens* and *Combretum aculeata* which appeared dead during the dry season had regenerated after the onset of rains. After 14 months of planting, the highest survival was recorded by *A. senegal* followed by *Combretum aculeata* and *A. seyal*, while the lowest was by *Leucaena leucocephala*, *Parkinsonia aculeata* and *Zizyphus mauritiana*.

The plots grazed zero and six months after planting had lower survival compared to control, but the difference in reduction was non-significant. The impact of grazing by goats on survival was high (35.75%), followed by cattle (48.00%) and sheep (58.50%).

Plant Growth: After a year of establishment, *Prosopis cineraria* had attained maximum height and collar girth. This was followed by *Parkinsonia aculeata* and *Bauhinia rufescens* for height and *Acacia nilotica*, *A. raddiana* and *Parkinsonia aculeata* for collar girth (Table 1). Grazing had adverse effect on the growth of MPTS, particularly on *Leucaena leucocephala*, *C. aculeata* and *Z. mauritiana*. The adverse impact was prominent in the plots grazed by goats followed by sheep and cattle. It was observed that MPTS seedlings are able to withstand the grazing pressure and compete with the local herbaceous species in the Sahelian pastures.

Apart from native species such as *Acacia senegal*, *Acacia seyal*, *Acacia nilotica* and *Combretum aculeata*, newly introduced *Prosopis cineraria* is performing well. The growth of *Parkinsonia aculeata* is impressive, but the survival is poor. *Leucaena leucocephala* was adversely affected by drought and browsing. *Bauhinia rufescens*, *Combretum aculeata* and *Zizyphus mauritiana* have good regeneration capacity in spite of heavy browsing. The observations will continue for 2-3 years to assess their impact on forage productivity.

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Table 1

Survival and growth of multipurpose tree species (MPTS) at Dahra, Senegal

SR. NO	SPECIES	SURVIVAL (%)		HEIGHT (CM)		COLLAR GIRTH (CM)	
		JUNE 96	OCT. 96	JUNE 96	OCT. 96	JUNE 96	OCT. 96
	<i>Acacia nilotica</i>	45.82	59.17	83.25	59.28	0.964	1.009
	<i>Acacia raddiana</i>	66.67	56.67	40.53	51.33	0.557	0.953
	<i>Acacia senegal</i>	73.33	68.33	32.61	55.10	0.609	0.787
	<i>Acacia seyal</i>	65.83	61.67	33.89	62.59	0.639	0.702
	<i>Bauhinia rufescens</i>	38.33	44.17	36.09	65.30	0.499	0.715
	<i>Combretum aculeata</i>	57.50	64.17	59.90	38.92	0.770	0.492
	<i>Leucaena leucocephala</i>	16.67	6.67	50.24	41.14	0.667	0.400
	<i>Parkinsonia aculeata</i>	55.83	20.83	40.16	83.87	0.824	0.927
	<i>Prosopis cineraria</i>	60.83	52.50	42.44	84.03	0.582	1.053
	<i>Zizyphus mauritiana</i>	51.67	40.00	50.16	43.78	0.528	0.421

PREFERENCE OF LIVESTOCK FOR MPTS

Species	Preference for Browsing		
	Cattle	Sheep	Goats
<i>Acacia senegal</i>	*	**	***
<i>Acacia nilotica</i>	***	**	***
<i>Acacia seyal</i>	*	***	***
<i>Acacia raddiana</i>	**	**	**
<i>Bauhinia rufescens</i>	***	***	***
<i>Combretum aculeata</i>	***	***	***
<i>Leucaena leucocephala</i>	***	***	**
<i>Prosopis cineraria</i>	***	***	***
<i>Parkinsonia aculeata</i>	*	*	*
<i>Zizyphus mauritiana</i>	*	**	**

Indicator : Heavy preference - ***, Normal preference - **, Poor preference - *.

PERFORMANCE OF DIFFERENT TREE SPECIES

Age After Planting (Months)	Highest	Least
SURVIVAL		
9	<i>Acacia senegal</i> <i>Acacia raddiana</i> <i>Acacia seyal</i>	<i>Leucaena leucocephala</i> <i>Bauhinia rufescens</i> <i>Combretum aculeata</i>
14	<i>Acacia senegal</i> <i>Combretum aculeata</i> <i>Acacia seyal</i>	<i>Leucaena leucocephala</i> <i>Prosopis aculeata</i> <i>Zizyphus mauritiana</i>
HEIGHT		
9	<i>Acacia nilotica</i> <i>Combretum aculeata</i> <i>Leucaena leucocephala</i>	<i>Acacia senegal</i> <i>Acacia seyal</i> <i>Bauhinia rufescens</i>
14	<i>Prosopis cineraria</i> <i>Parkinsonia aculeata</i> <i>Bauhinia rufescens</i>	<i>Combretum aculeata</i> <i>Leucaena leucocephala</i> <i>Zizyphus mauritiana</i>
COLLAR GIRTH		
9	<i>Acacia nilotica</i> <i>Parkinsonia aculeata</i> <i>Combretum aculeata</i>	<i>Bauhinia rufescens</i> <i>Zizyphus mauritiana</i> <i>Acacia raddiana</i>
14	<i>Prosopis cineraria</i> <i>Acacia nilotica</i> <i>Acacia raddiana</i>	<i>Leucaena leucocephala</i> <i>Zizyphus mauritiana</i> <i>Combretum aculeata</i>