Forage from Trees and Grasses of Silvipasture System in Degraded Land of Semiarid India

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Introduction

Rainfed agro-ecosystem has a distinct place in Indian Agriculture, occupying 67% of the cultivated area and supporting 65% of the livestock population (Venkateswarlu, 2005). The silvipasture systems involving suitable multi-purpose trees specially fodder trees and range grass species provide resilience by ensuring continued and multiple outputs such as, forage, fuelwood, fodder, fibre and industrial raw material, besides other positive environmental effects. Incorporation of fodder trees with grasses is perceived as a climate change-resilient cropping system for farmers linking climate change mitigation with adaptation (Mbow *et al*., 2014). The synergies of tree-grass association need to be explored and exploited by evaluating different fodder tree species with combination of grass species under degraded land and climatic condition. In many low input agro-ecosystems grasses are intercropped with legumes since legumes have an importance as a primary source of nitrogen (Thomsen and Haugaard-Nielsen, 2008). This study was planned to develop a silvipasture system with suitable tree and grass species on degraded land of semi arid condition to ensure the availability of quality fodder round the year.

Materials and Methods

The study was carried out at the Research Farm of Grassland and Silvipasture Management Division of ICAR-Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh, India. Four native fodder trees namely *Ficus infectoria*, *Madhuca. latifolia*, *Morus alba* and *Acacia nilotica* were selected for their evaluation with three grass species *viz Cenchrus ciliaris*, *Chrysopogon fulvus* and *Panicum maximum* and two legumes *viz*. *Clitoria ternatea* and *Stylosanthes seabrana*. Tree spacing of 5 X 5 m and grass and legumes rows spacing of 45 cm was kept. Thus a total of nine lines of grass and legumes, three lines of each were made between each of two rows of fodder tree. A total of 144 tree plants were transplanted in each plot of size 60 x 60 m. Split plot design was applied for experimentation with three replications. Growth parameters of the trees per cent survival, collar diameter (cm), height (m) crown spread (north-south and east-west directions) and green fodder yield of the grasses and legumes in all the treatments were measured annually in the months of November–December for trees and in September and December for grasses for two cuts. Thus all the data recorded were statistically analyzed and discussed at 0.5 percent of level.

Results and Discussion

Pruned biomass of fodder trees: Pruned biomass from fodder trees recorded yearly showed that among all tree species, *M. alba* provided higher biomass in the year 2012-13 and 2013-14 which was 4.73 and 3.83 kg per tree per year. However in the fourth year *i.e.* in 2014-15 *A. nilotica* had maximum (7.6) kg per tree per year followed by *M. alba* (6.7), *F. infectoria* (3.2) and minimum with *M. latifolia* (0.4) kg per tree per year (Fig. 1). Leaf fodder and hardwood ratio of pruned biomass of tree species clearly indicates that *M. latifolia* had maximum leaf fodder percentage in pruned biomass. It was 22.5 percent from *M. latifolia* followed by *F. infectoria* (21.14), *M. alba* (11.24) and minimum from *A. nilotica* (3.23) per cent only Fig 2. Higher biomass obtained from *A. nilotica* and *M. alba* is due to the fact that both the plant had initial high growth ability in arid and semi arid condition. *A. nilotica* is well recognized plant for arid ecosystem whose tap root helps in good growth. Similarly *M. alba* is also a versatile plant and had ability to adopt in range of climate conditions, tropical to temperate. However, higher leaf fodder from *M. latifolia* besides slow growth is due to wider foliage size

Forage production: Forage production of different grass and legumes combinations grown in fodder tree plots were recorded. Grass and legume forage yield from *F. infectoria* plot showed that among grasses *P. maximum* yielded highest biomass in comparison to all other grasses which was 68 t/ha green fodder yield (GFY) followed by *C. fulvus* (44.33) and *C. ciliaris* (41) t/ha during 2014-15 season. Similarly, among legumes *C. ternatea* had maximum production of 15t/ha and *S. seabrana* produced 26 t /ha. Under *M. latifolia* based silvipasture system increased trend of grass growth and biomass production was observed with advancement of year. Maximum forage of 70 t/ha GFY was received from *P. maximum*

followed by *C. fulvus* (59.66 t /ha) and *C. ciliaris* (34 t/ha). Similar trend was also observed in *M. alba* and *A. nilotica* based silvipasture system (Table 1). *P. maximum* had higher biomass among all the grass tested. The reason behind maximum forage from *P. maximum* is that it has genetic ability to produce more biomass within short period. The regeneration ability, fast growth and wider leaf blade are some of the factors contributed in higher production. Among legume *S. seabrana* produced more biomass than *C. ternatea* due to having maximum number of branches and higher woody portion. Regeneration in *S. seabrana* was also more than *C. ternatea.*

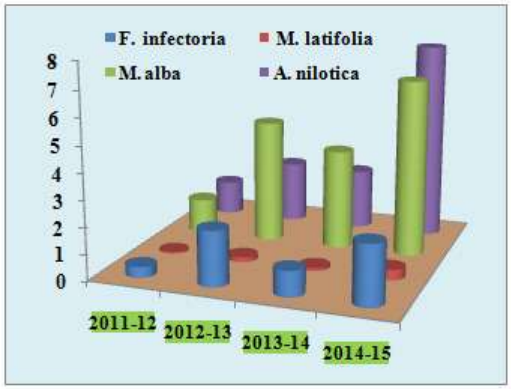

Fig.1 Pruned biomass (kg) tree^{-1} yr^{-1}

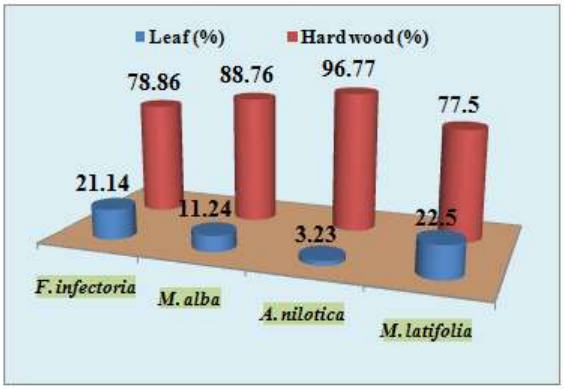

Fig. 2 Contribution of fodder (%) from pruned tree biomass

Tree	Average green fodder (GFY) production of different grasses and legumes under different tree combination (t/ha)					
	C. fulvus	*P. maximum*	*C. ciliaris*	*C. ternatea*	*S. seabrana*	Mean
Ficus infectoria	44.33	68.00	41.00	15.00	26.00	38.86
Madhuca latifolia	59.66	70.00	34.00	14.13	24.00	40.36
Morus alba	54.00	76.00	31.00	10.00	20.00	38.20
Acacia nilotica	46.33	64.00	28.00	9.00	21.00	33.66
Mean	51.08	69.50	33.50	12.03	22.75	
Factors				C.D.		SE(m)
Tree (A)				1.85		0.645
Grass and legume (B)				2.07		0.721
Factor(A X B)				4.144		1.442

Conclusion

The study concludes that fodder tree based silvipasture system provides round the year good biomass from degraded land of semiarid region. Besides production of forage from grasses and legumes of silvipasture system, fodder trees help in augmenting environmental services and improving ecology. Growing of grasses and legumes with different fodder trees in degraded land improves soil fertility due to enhanced microbial activities leading to decomposition of leaf litter and nutrient cycling. Establishment of such system will certainly improve the soil health thus and after few years waste land can be converted into best land.

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