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Growth and yield performance of fodder trees and grasses under silvipastoral systems in dryland farming

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Abstract

Agricultural production has improved from the level of sufficiency to sustainability in the six decades after green revolution. From crop production various diversifications have been undergone in the agricultural sector where livestock forms an irrevocable segment of human livelihood. Thus agricultural production now has to face the growing human and livestock population for their food needs. The adversities of climate change are also travelling parallel with the demand for food supply. This proves the need for more sustainable production that would not harm the environment further. Forest tress are the investments on climate change mitigation through afforestation and Carbon sequestration. There is a dual role for fodder trees both as an investment on climate change mitigation action and remuneration for farmers. However, the impact of climate change would further aggravate the existing productivity contrasting in the Dry land agriculture areas like Sivagangai district. The experiment of interaction between different tree fodder and fodder crops was able to reveal that *Albizia lebbek* was growing in faster pace than *Pterocarpus marsupium* and *Thespesia populnea*, while the green and dry fodder yield was higher in Fodder Sorghum (CO FS- 29) compared to Cenchrus, Stylosanthus and Desmanthus species. Thus the Silvipastural system of *Albizia lebbek* intercropped with Fodder Sorghum would be highly remunerable to the farming community when incorporated into the dry tracts of Sivagangai district.

Keywords: Silvipasture, tree fodder, fodder crops, mitigation

Introduction

Dry land agriculture is the livelihood of major sector of farmers who completely depend upon Monsoonal rainfall to take up the crop production. Through the dependence of rainfall, the length of growing period varies yearly making them vulnerable of crop failure when there is any discrepancy in monsoonal activity. Thus a proper remuneration to make them sustainable and less vulnerable is necessary to balance their livelihood. Animal husbandry is a good option in Dry land areas provided the cattle feed is available without much fluctuations in demand and supply. This in turn depends on the fodder production within the area of animal productivity. During the movement of self-sufficiency, the food for cattle will also need limelight to reduce the expenditure due to external sourcing. Under the pressure of climate change where the frequency of extreme weather events like drought is increasing (Gebrehiwot *et al*., 2011) [1]

Sivagangai district is a major dry tract of the Southern zone with 861.8 mm annual rainfall, where the length of growing period of crops is hardly three to four months in a year. Even though it has different cropping patterns like Upland rice / millets / chillies / cotton + pulses Maize / sorghum / gingelly / groundnut / sunflower etc., a sustainable form of income is still a setback in the farmer livelihood of this region. Investments on agricultural inputs and other crop management activities would provide an additional burden on the farmers. Fodder crops having shorter durational capacity require less amount of rainfall to grow and are a good source of cattle feed. The tree fodder crops can provide wood as a remunerative venture followed by the leaves for animal husbandry (Legrève and Duveiller 2010) [4]. Intercropping fodder trees with fodder crops can benefit with year-long production of fodder until the fodder trees are capable of producing woods (Gebremedhin *et al.*, 2003) [2].

Experimentation of the growth and yield contribution of interaction between the fodder tree crops and the fodder crops provides a new insight on benefits of incorporating Silvipasture in the dry tracts of Sivagangai district. Silvopastural system combine the two large entities viz., tree crops and livestock sector into one unit (Rigueiro-Rodríguez *et al*., 2011) [6]. There had been successful studies of introducing indigenous trees crops and fodder crops for Slivipasture model (Mulubrhan Balehegn, 2017) [5]. Based on the motives of sustaining farmer's income the following objectives were framed to estimate the fodder yield of grass and legume fodder grown under trees and also to assess the magnitude of reduction in the yield of fodder crops due to the age of trees and further to estimate the fodder production potential of the selected fodder trees under Silvipasture system at periodical interval.

Materials and Methods

Study area

The entire study on the Silvipature trial was conducted in Agricultural Research Station, Chettinad during August 2013 to July 2016 period. The tree species were planted during December 2013 and their growth performance was evaluation a six month intervals for Tree height (cm) and Basal girth (cm). Four species of fodder trees were selected and intercropped with four species of fodder crops. The interaction performance was studied and then recorded as green fodder yield (kg/ha) and dry fodder yield (kg/ha).

Experimental Design

Fodder Trees	*Albizia lebbek* (T_1) *Pterocarpus marsupium* (T_2) *Thespesia populnea* (T_3) Open (T_4)
Tree spacing	5m x 5m
Fodder crops	Stylosanthus (F1) Cenchrus (F2) Fodder Sorghum: CO FS- 29 (F3) Desmanthus (F4)
Design	RBD (Factorial)
Replication	3
Statistical tool	Egress software

Results and Discussion

The results showed that all the tree species are performing well. Among them *Albizia lebbek* recorded the maximum height and basal girth followed by *Pterocarpus marsupium* and *Thespesia populnea* (Table 1, Fig. 1, 2).

Table 1: Mean Tree Height and Basal Girth of fodder tree species at six-month interval

Tree species	Tree Height (cm)				Basal Girth (cm)			
	6MAP	12MAP	18MAP	24MAP	6MAP	12MAP	18MAP	24MAP
Thespesia populnea	79.8	130.8	206.5	233.0	3.7	6.7	13.4	17.7
Pterocarpus marsupium	59.0	108.8	231.8	292.9	2.0	3.9	12.5	18.4
Albizia lebbek	104.2	156.0	258.9	349.1	3.5	5.3	12.7	20.3
SED	4.19	9.32	13.22	13.22	0.12	0.37	0.59	0.59
CD (P≤0.05)	9.13	20.29	27.0	27.0	0.27	0.80	1.2	1.2

MAP- Months after Planting

Table 2: Effect of fodder trees on yield of fodder intercrops under the Silvipature trial in Sivagangai district:

	First year (Under one year old)								Second year (under two year old)							
	Green fodder yield (kg/ha)				Dry fodder yield (kg/ha)				Green fodder yield (kg/ha)				Dry fodder yield (kg/ha)			
	F1	F2	F3	F4	F1	F2	F3	F4	F1	F2	F3	F4	F1	F2	F3	F4
T_1	4.5	3.4	5.3	0.8	1.9	2	2.4	0.4	3.74	2.23	5.21	0.76	1.47	1.34	2.3	0.35
T_2	4.1	3.3	5.2	0.8	1.7	1.9	2.3	0.4	3.75	2.25	4.94	0.72	1.53	1.35	2.06	0.34
T_3	3.9	3.1	4.9	0.7	1.5	1.8	2.1	0.4	3.78	2.3	4.9	0.66	1.54	1.38	2.03	0.32
T_4	4.2	3.3	5.4	0.8	1.7	2	2.3	0.4	3.81	2.52	5.26	0.74	1.53	1.53	2.24	0.35
	SED		CD≤0.05		SED		CD≤0.05		SED		CD≤0.05		SED		CD≤0.05	
T	0.32		0.64		0.15		0.31		0.25		0.51		0.1		0.2	
F	0.32		0.64		0.15		0.31		0.25		0.51		0.1		0.2	
TF	0.63		1.27		0.3		0.61		0.51		1.03		0.2		0.4	
T_1- *Albizia lebbek*			T_2- *Pterocarpus marsupium*				T_3- *Thespesia populnea*				T_4- Open					
F1- Stylosanthus			F2- Cenchrus				F3- Fodder Sorghum				F4- Desmanthus					

Among the fodder grass, fodder Sorghum (CO FS- 29) recorded the maximum green and dry fodder yield in the first year followed by Cenchrus, Stylosanthus and the lowest yield was recorded in Desmanthus (Table 2 and Fig. 3, 4). During the second year the reduction in yield of fodder crops was noticed due to the above and below ground interactions among the fodder trees and fodder crops (Table 2, Fig. 5, 6). The percentage of average yield reduction of green and dry fodder were 10.24%, 30.95%, 2.66% and 8.11% and 11.11%, 30.71%, 2.67%, and 14.25% in Stylosanthus, Cenchrus, Fodder Sorghum and Desmanthus, respectively.

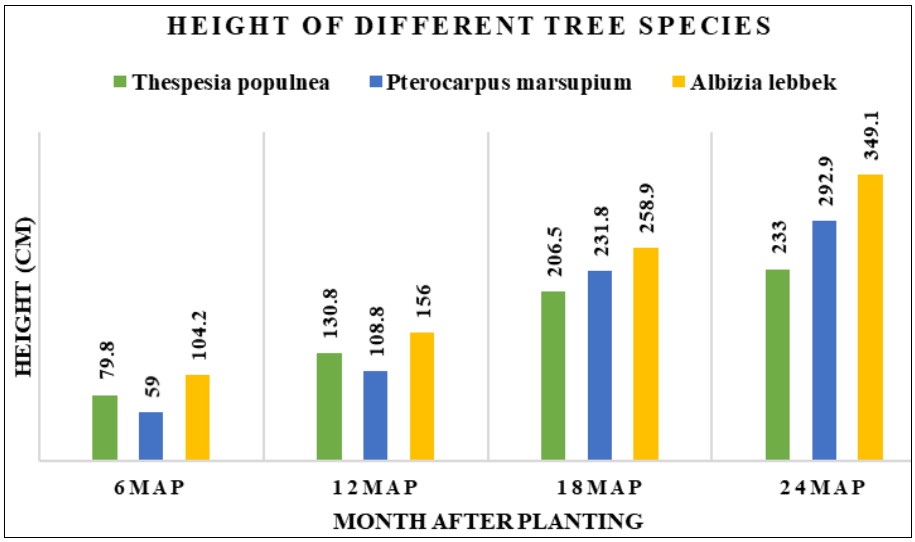

Fig 1: Comparison of height (cm) between different tree species in the drylands of Sivagangai

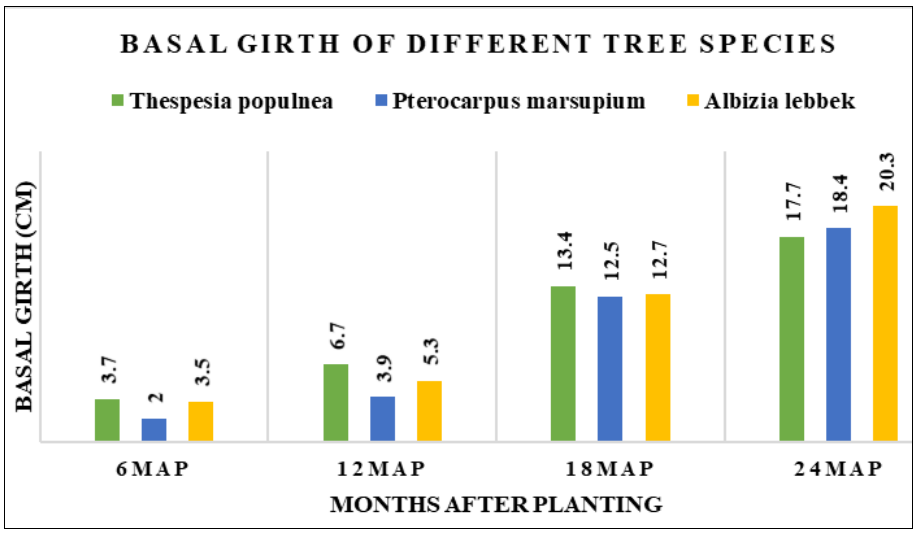

Fig 2: Comparison of basal girth (cm) between different tree species in the drylands of Sivagangai

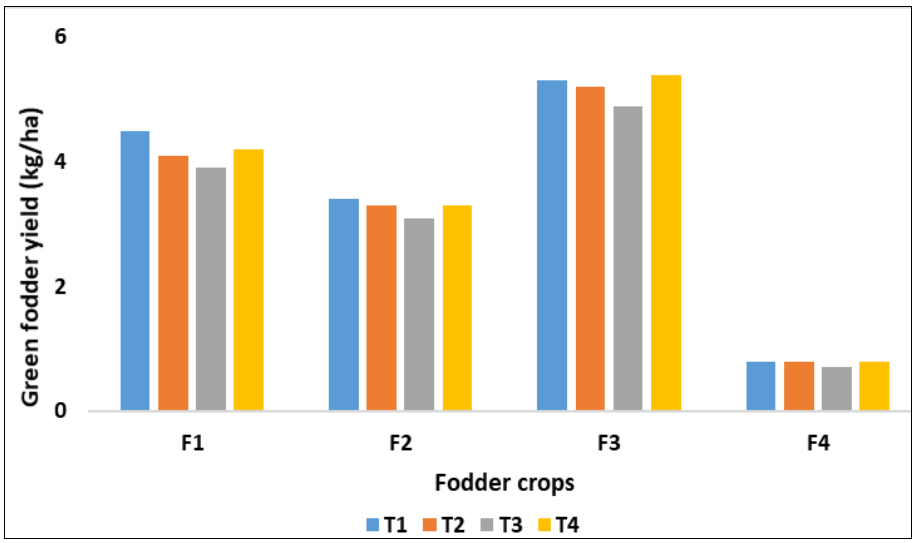

Fig 3: Effect of fodder trees on green fodder yield of fodder intercrops under Silvipasture trial in Sivagangai district for one year duration

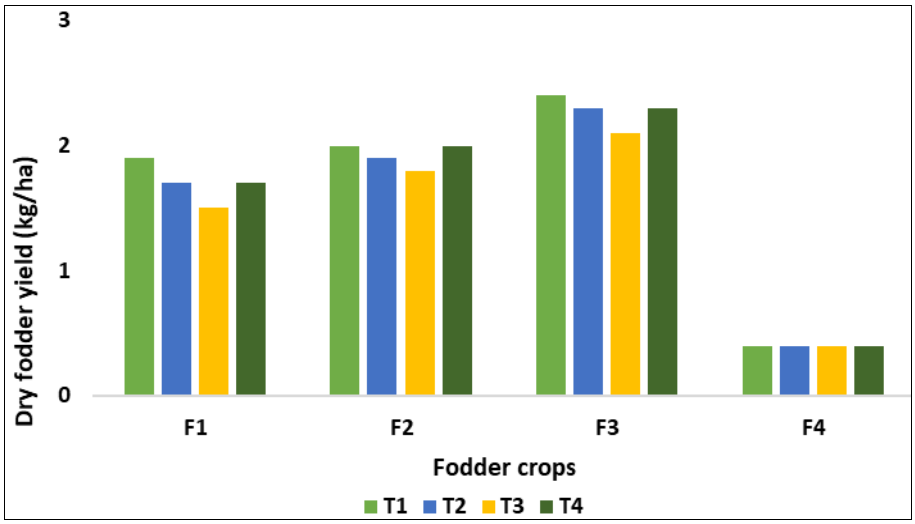

Fig 4: Effect of fodder trees on dry fodder yield of fodder intercrops under Silvipasture trial in Sivagangai district for one year duration

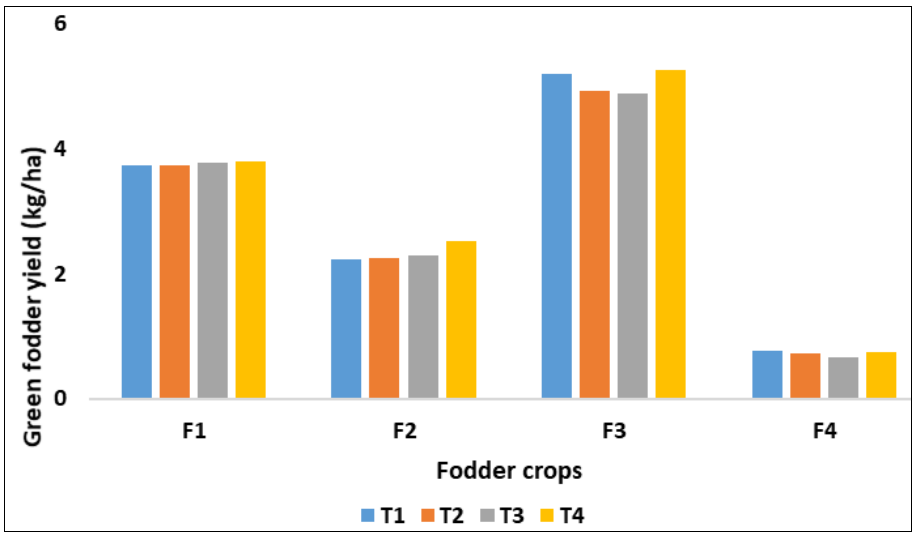

Fig 5: Effect of fodder trees on green fodder yield of fodder intercrops under Silvipasture trial in Sivagangai district for two year duration

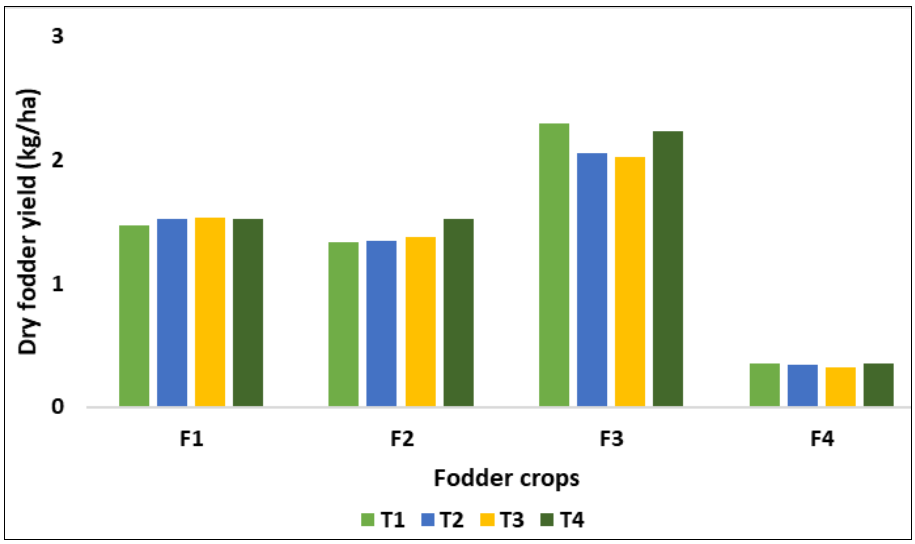

Fig 6: Effect of fodder trees on dry fodder yield of fodder intercrops under Silvipasture trial in Sivagangai district for one year duration

Conclusion

The research concludes that the fodder grass are productive in conjunction with the fodder trees that could generate more effective farm income. Another benefit of incorporating tree fodder and fodder grass is that it forms a better climate change mitigation practice like the afforestation model that does not focus only on climate change at the cost of farm income, rather benefits the

farmers and environment like a balanced strategy. The canopy cover producing nutritive fodder, wood, fruits and other valuable products from the tree crops makes it to be a preferable choice. India supports nearly 18 per cent of the world livestock population, so better quality fodder and production to meet out the demand is necessary. This research supports the ideas of climate change mitigation and self-sufficiency in fodder production for livestock, where the results have indicated that the Fodder Sorghum and Stylosanthus species have proved to be higher fodder yielding crops.

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