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Performance of Fodder Grasses with Fast Growing Timber Trees under Silvipastoral System in Rainfed Coastal Ecosystem

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ABSTRACT

A study was conducted at the experimental site of All India Co-ordinated Research Project on Agroforestry, during 2018-2019. The experiment was laid out in a Randomized Block Design with nine treatments and three replications. *Acacia mangium* with Setaria silvipastoral system recorded the maximum tree height (12.2 m), DBH (11.8 cm) and crown spread (4.2 m) after 42 months of planting. The highest green forage yield of 20.9 t ha^{-1} was obtained with Guinea (*Megathyrus maximus*) in *Acacia mangium* followed by *Samanea saman* with Guinea system (19.5 t ha^{-1}). Relative yield of grasses was maximum under *Acacia mangium* (82.6%) and lowest under *Acacia auriculiformis* (73.1%). The highest net return (Rs 20, 150 ha^{-1}) and B : C (2.8) was recorded with *Samanea saman* with Guinea system Rs 18,050 ha^{-1} and 2.6 respectively. In silvipastoral system maximum soil moisture storage was recorded with Guinea followed by Thin Napier (*Pennisetum purpureum*) and Setaria (*Setaria glauca*) irrespective of trees associated. The light interception was lowest under *Acacia mangium* followed by *Acacia auriculiformis* and *Samanea saman.*

Keywords Fodder grasses, Fast growing, Timber trees, Silvipastoral system, Coastal rainfed.

INTRODUCTION

The silvipastoral system is the production of woody plants combined with pastures. There is severe shortage of green fodder in our country as well as in the states, therefore it is urgently required to develop location and situation specific silvipastoral system for rainfed upland condition. The farmers of coastal Odisha mostly opted for *Samanea saman* because of its fast growing nature and good fuelwood, similarly *Acacia auriculiformis* and *Acacia mangium* are also very fast growing timber trees. These tree species have multi uses like furniture making and household material making and good for firewood purpose. Trees and shrubs are increasingly recognized as important components of animal feeding, especially as suppliers of protein. In difficult environmental conditions, where the available grazing is not sufficient to meet the maintenance requirements of animals for part of

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the year, the contribution from trees and shrubs is significant. Grasses are well suited in dry regions and require a little amount of water to survive throughout the year.

MATERIALS AND METHODS

Location and soil characteristics

The experimental site is situated inside the AICRP on Agroforestry Research Station of OUAT, Bhubaneswar which is located at 20°15" N longitude and 85°52' East latitude with an altitude of 25.9 m above mean sea level. The study area falls in the sub-tropical zone, which is about 64 km away from the Bay of Bengal in the East. The experimental field is fairly levelled and well drained. Soil is sandy loam texture. It is rich in oxides of iron and aluminium but poor in di-basic cations and soluble salts. Soil samples were taken before conducting the experiment from a depth of 0-15 cm taking all the possible precautions prescribed for soil sampling. The processed samples were subjected to appropriate physical and chemical analysis.

Experimental details

The experiment was laid out in a Randomized Block Design (RBD) with three replications, during 2018–2019. It consisted of nine treatments combinations comprizing of nine silvipastoral systems involving three silvi tree species e.g. *Acacia mangium, Acacia auriculiformis* and *Samanea saman* and three grass species i.e. Guinea (*Megathyrsus maximus*), Thin Napier (*Pennisetum purpureum*) and Setaria (*Setaria glauca*). Three control plots of grasses were also maintained for comparing the performance of grasses under sole and silvipasture systems. The planting geometry of silvi trees and grasses was 6 × 2 m^2 and 0.75 × 0.50 m^2 respectively. At the time of final land preparation well decomposed FYM @ 5 t ha^{-1} and recommended fertilizer dose of 80-40-40 kg N-P_2O_5-K_2O ha^{-1} was applied in the form of Urea, Diammonium phosphate (DAP) and Murate of potash (MOP), respectively. Half of nitrogen along with full phosphorus and potash were applied as basal and rest of nitrogen in three splits as top dressing after each cutting. It was worked out to compared the profitability of different treatments. The cost involved in production of different silvipastoral systems was estimated and converted to per hectare value, then the return obtained from each treatment were evaluated and the net return (Rs ha^{-1}) was worked out by subtracting the cost of cultivation from the gross return obtained. The benefit cost ratio was calculated by dividing the gross return by the cost of cultivation and presented to assess the profitability of different treatments. To determine the significance between the treatment means and to draw valid conclusion, statistical analysis was made. Data obtained from various observations were subjected to statistical analysis by adopting appropriate method of Analysis of Variance . The difference of the treatments mean was tested using Critical Difference (CD) at 5% level of probability (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Growth of timber trees under silvipastoral system

Tree height

The height of tree species varies significantly when grown with different forage crops, at 42 months after planting the highest tree height of 12.2 m of *Acacia mangium* was recorded with Setaria followed by *Acacia mangium* with Guinea (11.60 m) and lowest tree height of 3.3 m was recorded in *Samanea saman* with Thin Napier system (Table 1). The overall growth showed that *Acacia mangium* is the fastest growing and significantly higher than *Acacia auriculiformis* and *Samanea saman* irrespective of grass species

Table 1. Growth of silvi trees in silvipastoral system.

Treatments		Plant height (m)	DBH (cm)	Crown spread (m)
Months after planting		42	42	42
	Guinea	11.6	10.7	4.3
A. mangium	T. Napier	10.4	11.5	4.8
	Setaria	12.2	11.8	4.2
	Guinea	6.4	6.2	3.1
A. auriculiformis	T. Napier	6.1	5.9	3.6
	Setaria	7.0	6.8	3.9
	Guinea	3.8	3.7	1.7
S. saman	T. Napier	3.3	3.4	1.5
	Setaria	4.1	4.7	2.1
CD 5%		1.18	1.27	0.92

Table 2. Relative green forage yield of grasses.

Grasses	Green forage yield (t/ha) Associated tree species					Yield recovery (%)
	Sole	*A. mangium*	*A. auriculiformis*	*S. saman*	Mean	
Guinea	24.5	20.9	18.3	19.5	19.6	79.9
Thin Napier	23.1	19.2	16.7	16.2	17.4	75.2
Setaria	17.4	13.6	12.5	12.7	12.9	74.3
Mean	21.7	17.9	15.8	16.1	16.6	
Relative yield (%)	100	82.6	73.1	74.5		

associated at all stages of study. These corroborate the findings of Yadav et al. (2014).

Diameter at Breast Height (DBH)

At 42 months after planting, the highest DBH of 11.8 cm was found in *Acacia mangium* with Setaria system followed by *Acacia mangium* with Thin Napier system (11.5 cm) and *Acacia mangium* with Guinea system (10.7 cm). The DBH of *Samanea saman* (3.4 cm) found to be lowest in *Samanea saman* with Thin Napier system. The growth trend was similar to tree height in all systems. *Acacia mangium* recorded significantly higher DBH than other two tree species at all stages.

Crown spread

In silvipastoral system crown spread of the tree varies from 1.5 to 4.8 m. The trend was similar to that of the other growth parameters like height and DBH. The maximum crown spread of 4.8 m was recorded in *Acacia mangium* with Thin Napier system followed by that of *Acacia mangium* with Guinea (4.3 m). The minimum crown spread of 1.5 m was recorded in *Samanea saman* with Thin Napier system (Table 1).

Performance of fodder grasses

The relative yield of three fodder grasses (Guinea, Thin Napier and Setaria) were assessed with three fast growing timber trees (*Acacia mangium, Acacia auriculiformis* and *Samanea saman*) during *kharif* 2018. Which were planted during *kharif*, 2015 with the onset of monsoon. The maximum green forage yield was obtained from Guinea (19.6 t/ha) from three cuttings and Thin Napier was the next best with a yield of 17.4 t/ha during 2018 (Table 2). Highest yield recovery percentage was recorded with Guinea (79.9%). Economics of cultivation of fodder crops in silvipastoral system are presented in Table 3. Highest benefit cost ratio of 2.8 was obtained from

Table 3. Yield and economics of the silvipastural system. Sale price of green forage (Rs 1,500 per ton) and cost of cultivation of fodder grasses (Rs 11, 200 per hectare).

Treatments		Inter crop fodder yield (t/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit : Cost ratio
Tree species	Fodder grasses				
	Guinea	20.9	31350	20150	2.8
A. mangium	Thin Napier	19.2	28800	17600	2.6
	Setaria	13.6	20400	9200	1.8
	Guinea	18.3	27450	16250	2.5
A. auriculiformis	Thin Napier	16.7	25050	13850	2.2
	Setaria	12.5	18750	7550	1.7
	Guinea	19.5	29250	18050	2.6
S. saman	Thin Napier	16.2	24300	13100	2.2
	Setaria	12.7	19050	7850	1.7
	Guinea	24.5	36750	25550	3.3
Sole	Thin Napier	23.1	34650	23450	3.1
	Setaria	17.4	26100	14900	2.3

Guinea grass in association with *Acacia mangium* followed by thin Napier with *Acacia mangium* (2.6). Our findings are in agreement with those of Barsila et al. (2013) .

Economics of silvipastoral systems

Gross return

It was observed that the gross return from the grasses grown in open conditions was more as compared to respective silvipastoral systems (Table 3). Under silvipastoral system, the highest gross return was obtained from *Sole* Guinea system (Rs 36, 750 ha^{-1}). The lowest gross return was found in *Acacia auriculiformis* with Setaria system (Rs 18,050 ha^{-1}).

Net return

Similar observation was noticed in the net return (Table 3.). It was observed that the maximum net return was obtained from the *Sole* Guinea system (Rs 25,550 ha^{-1}). The lowest net return was obtained from *Acacia auriculiformis* with Setaria system (Rs 7,550 ha^{-1}).

Benefit cost ratio

The benefit cost ratio of grasses in respective open field condition was found to be higher as compared to respective silvipastoral systems (Table 3). In these silvipastoral systems, the value of B : C varied from 1.7 to 3.3. In the *Sole* Guinea based silvipastoral system, the B : C was found to be highest (3.3) , but it was lowest in *Acacia auriculiformis* with Setaria system (1.7) . Simillar result were reported by Rai et al. (2009).

CONCLUSION

The study indicated that among silvipastoral systems *Acacia mangium* with Guinea (*Megathyrus maximus*) is more productive and profitable.

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