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Agrihortisilvicultural system with legume intercrop under rainfed agroeco system

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Abstract

Four legume field crops was taken in the interspaces of three popular fruit tree crops and one silvi tree during rainy season of 2015, 2016 & 2017. The productivity, profitability and change in soil fertility status was studied. The mean data of three years experimentation revealed that Arhar (*Cajanus cajan*) was the best legume intercrop with net return of Rs. 36,920, Rs. 32,920 and Rs. 18,520 per hectare per year, when intercropped with Mango (*Mangifera indica*) + Eucalyptus hybrid (*Eucalyptus globulus*), Jackfruit (*Artocarpus heterophyllus*) + Eucalyptus hybrid (*Eucalyptus globulus*) and Cashewnut (*Anacardium occidentale*) + Eucalyptus hybrid (*Eucalyptus globulus*) having benefit cost ratio (BCR) 2.48, 2.32 and 1.74 respectively, followed by Cowpea (*Vigna unguiculata*).

Keywords: Agrihortisilvicultural system, legume intercrop, rainfed agroeco system

Introduction

Farmers have natural preference for horticultural based agroforestry system. Inclusion of fruit trees with fast growing timber trees in an agroforestry system could be remunerative which impacted under stability of their income (Dixon *et al*, 2001) [2]. Mango (*Mangifera indica*) is the most popular fruit trees of Odisha followed by Cashewnut (*Anacardium occidentale*) and Jackfruit (*Artocarpus heterophyllus*). Eucalyptus hybrid (*Eucalyptus globulus*) as a fast growing timber used as a filler silvi tree that can be harvested before fruit crops attains their full bearing stage. Leguminous intercrops such as Arhar (*Cajanus cajan*), Ground nut (*Arachis hypogaea*), Black gram (*Phaseolus mungo*) and Cowpea (*Vigna unguiculata*) are also liked by the farmers due to their economic value and soil fertility enhancing nature. Keeping in view of the above facts one on station field experiment was conducted with an objective to assess the performance of these legume intercrops in agrihortisilvicultural system.

Materials and Methods

A field study on agroforestry system management in rainfed situation was conducted at Agroforestry Research Station (OUAT, Bhubaneswar) for three consecutive years during 2015 to 2017 on lateritic sandy loam and well-drained soil having pH (5.47), EC (0.18 ds/m), OC (4.7 g/kg), available N (208.6 kg/ha), available P (48.5 kg/ha) and available K (146.5 kg/ha). The experiment was laid out in randomised block design (RBD) and replicated thrice. It consisting of 12 treatments out of it three fruit crops *viz.* Mango (Cv. Amrapalli), Jackfruit (Cv. Phulbani selection) and Cashewnut (Cv. Balabhadra) and four legume field crops *viz.* Arhar (Cv. Asha), groundnut (Cv. Smruti), Blackgram (Cv. PU-31) and Cowpea (Cv. Utkal manik). The treated and rhizome inoculated seeds of legume field crops were shown in the line with their recommended spacing and fertilizer in the alleys of tree rows (8m x 7.5 m) in the first fortnight of July. Thinning and weeding was done at 15 days after sowing. The filler Eucalyptus hybrid tree planted in between two fruit trees in east west direction at 8m interval. The need based plant protection measure was taken for the entire vegetation. During the investigation period for consecutive three years monsoon rainfall was normal, annual precipitation (1493.7 mm), mean rainy days (113), average bright sunshine hour (8.6 per day), mean maximum and minimum temperature ranges from 28.2 °C – 38.8 °C and 14.4 °C – 27.2 °C respectively. The observations were recorded on following standard operational research methods. Economic analysis of each treatment was done on the basis of prevailing market price of inputs and output obtained. The soil fertility related characters are determined by following the standard procedures. The data was subjected to analysis of various for statistical significance among the treatments (Gomez and Gomez, 1976) [3].

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Results and Discussion

Growth of fruit trees

Data on growth of trees were recorded at 30 months after planting, statistically analyzed and presented in Table 1. Among the fruit trees jackfruit recorded the highest plant height followed by cashew and mango in general and all the fruit trees recorded highest tree height with cowpea followed

by blackgram as an intercrops. Jackfruit attained a height of 4.54 m with basal girth of 28.98 cm at 30 months of planting when intercropped with cowpea. Cashew and mango attained plant height of 3.53 m and 1.97m with basal girth of 28.63 cm and 16.33 cm at 30 months of planting when intercropped with cowpea respectively. The leaf litter accumulation under different fruit and silvi trees were negligible during third year.

Table 1: Growth of fruit trees in agrihortisilvicultural system

Fruit Tree species	Intercrops	Plant height (in meter)			Basal girth (In cm)			Crown spread (in meter)		
		6 month	18 month	30 month	6 month	18 month	30 month	6 month	18 month	30 month
Mango	Arhar	0.45	1.24	1.61	4.33	6.50	13.25	0.34	0.62	1.22
	Groundnut	0.49	1.27	1.86	4.87	6.50	14.08	0.37	0.65	1.23
	Blackgram	0.48	1.35	1.95	4.50	6.58	14.83	0.32	0.77	1.59
	Cowpea	0.41	1.48	1.97	4.67	6.93	16.33	0.35	0.90	1.73
Jackfruit	Arhar	0.89	2.36	2.93	4.50	10.50	19.03	0.48	1.34	1.66
	Groundnut	1.24	2.45	3.70	6.83	12.19	25.08	0.61	1.47	2.24
	Blackgram	1.15	2.52	4.50	5.67	13.17	27.52	0.56	1.67	2.79
	Cowpea	1.05	2.77	4.54	4.33	13.33	28.98	0.51	1.73	2.83
Cashew	Arhar	0.59	1.98	2.97	5.00	10.33	25.87	0.43	1.61	3.84
	Groundnut	0.69	2.51	3.10	6.07	11.68	26.00	0.61	1.86	4.04
	Blackgram	0.68	2.93	3.32	6.00	13.53	31.08	0.60	2.27	4.12
	Cowpea	0.56	3.11	3.53	5.33	13.85	28.63	0.42	2.65	4.08
CD(0.05)		0.19	0.65	0.63	2.12	3.40	6.91	0.13	0.38	0.79

Soil fertility status

Analysis of soil after one month of intercrops (Table 2) viz. arhar, groundnut, blackgram and cowpea grown with the fruit tree species in agrihortisilvi system indicated lower values of available N with arhar followed by groundnut, cowpea and blackgram, lower values of available P with blackgram followed by cowpea, arhar and groundnut and lower values of available K with arhar followed by groundnut, blackgram and cowpea and the trend was similar irrespective of fruit tree

species grown. Arhar was found to be more exhaustive with higher uptake values of N and K and blackgram with P. Organic carbon in this system varied from 4.70 g/kg in jackfruit + arhar to 5.9 g/kg in mango + blackgram combination. Increase in available nutrients and organic carbon was observed than the initial soil status results suggested that soil fertility was improved due to agroforestry intervention. Similar findings was also observed by Dagar and Singh, 2001 [1].

Table 2: Soil fertility status as influenced by trees and crops in agrihortisilvi system (Three years mean data, 2015-17)

Fruit Tree species	Intercrops	pH	Organic carbon (g/kg)	Available N(kg/ha)	Available P(kg/ha)	Available K(kg/ha)
Mango	Arhar	5.51	5.1	223.7	59.1	150.5
	Groundnut	5.53	5.3	235.1	67.5	158.3
	Blackgram	5.66	5.9	254.6	56.2	162.2
	Cowpea	5.61	5.4	242.5	58.7	168.1
Jackfruit	Arhar	5.49	4.7	211.7	57.6	148.7
	Groundnut	5.52	5.1	216.4	62.3	156.8
	Blackgram	5.62	5.8	232.6	51.7	160.1
	Cowpea	5.58	5.3	219.2	54.8	165.5
Cashew	Arhar	5.48	4.8	209.6	52.3	148.1
	Groundnut	5.48	4.8	211.7	58.7	151.8
	Blackgram	5.57	5.2	224.1	50.6	154.1
	Cowpea	5.51	5.0	218.5	51.7	162.3
Initial soil status		5.47	4.7	208.6	48.5	146.5

Economics

Economics of the agrihortisilvicultural system are presented in the Table 3. Among the intercrops arhar produced the highest net return of Rs 36920, 32920 and 18520/ha/yr with benefit cost ratio (BCR) 2.48, 2.32 and 1.74 with three fruit trees i.e. mango, jackfruit and cashew respectively. Cowpea

was the next best crop which recorded net returns of RS 8000, 5500 and 4720 /ha/yr with BCR 1.32, 1.22 and 1.19 when intercropped with mango, jackfruit and cashew respectively. Shade had absolutely no effect on the growth and economic yield of these intercrops as the tree canopy during the period was very less.

Table 3: Economics of agrihorticultural systems (Three years mean data, 2015-17)

Fruit Tree species	Intercrops	Intercrop yield (kg/ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
Mango	Arhar	774	61920	36920	2.48
	Groundnut	1040	41600	6600	1.19
	Blackgram	387	30960	5960	1.24
	cowpea	1650	33000	8000	1.32
Jackfruit	Arhar	724	57920	32920	2.32
	Groundnut	990	39600	4600	1.13
	Blackgram	342	27360	2360	1.09
	cowpea	1525	30500	5500	1.22
Cashew	Arhar	544	43520	18520	1.74
	Groundnut	925	37000	2000	1.06
	Blackgram	330	26400	1400	1.05
	cowpea	1486	29720	4720	1.19
Control	Arhar	810	64800	39800	2.59
	Groundnut	1165	46600	11600	1.33
	Blackgram	382	30560	5560	1.22
	cowpea	1877	37540	12540	1.50
CD (0.05)		107			

Crop	Cost of cultivation (in rupees/ha)
Arhar	- 25000
Groundnut	- 35000
Blackgram	- 25000
Cowpea	- 25000

Unit sale price	(in rupees)
Arhar	- 80/ kg
Groundnut	- 40/ kg
Blackgram	- 80/ kg
Cowpea	- 20/ kg

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