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Research Paper

Agroforestry practices for crop, soil improvement and economic gain in dry lands of Hyderabad region of Andhra Pradesh

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ABSTRACT

In agroforestry practice for crop improvement in poor and marginal soils indicated that sunflower grown when intercropped in six year old *Hardwickia binata* after stylo recorded higher seed yield (342 kg ha^{-1}) than grown after fallow in *Hardwickia binata* (248 kg ha^{-1}). The total monetary returns from tree and crop were considerably higher when sunflower grown as intercrop in *Hardwickia binata* (Rs 6,593). In thirteen year old *Faidherbia albida* trial during *kharif* 2001 revealed that the seed yield of maize + soyabean when grown as intercrops in *Faidherbia albida* was markedly increased (29.4 q ha^{-1}) when compared to that of sole cropped maize (16.7 q ha^{-1}). The total monetary returns from the system (Tree + crop) were increased considerably when maize grown as intercrop in trees (Rs 11,276) over maize grown as sole crop (Rs 3,764). The soil physical properties revealed that the bulk density of soil was reduced in surface and subsurface soils in all the tree based cropping systems as compared to fallow (1.61 and 1.68 Mg kg^{-1}) and agricultural lands (1.62 and 1.67 (Mg kg^{-1}). The lowest being in Eucalyptus system (1.38 and 1.62 Mg kg^{-1}) followed by agri-horticulture system. Whereas, water holding capacity and infiltration rate was found maximum in agri-horti system (30 and 30% at 0-15 and 15-30 cm and 2.1 cm hr^{-1} at 30 cm depth respectively) and minimum was recorded in fallow land use system at both soil depths (15 and 10% at 0-15 and 15-30 cm and 2.1 cm hr^{-1} at 0-30 cm depth respectively). Regarding nutrient status, the total nitrogen and carbon was more, where soil was covered with tree plantation as compared to fallow and agricultural lands. Maximum total nitrogen (0.076 and 0.071% and total carbon (0.89 and 0.76 % at both depths respectively) was resulted in agri-horticultural system followed by silvi pastoral system being 0.067, 0.064 % and 0.72, 0.70%.

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Key words : Agroforestry, Dry land use system, Soil improvement, *Faidherbia albida*

INTRODUCTION

Arable farming since last several years specially in dry lands has not proved profitable mainly on account of aberrations of monsoons. The marginal, sub marginal farmers of SAT areas who are dependent on sole crop farming are suffering for remunerative returns. This is mainly because of low investment due to risk involved and limited adoption of improved dry land technology. Under such situations, a system of integration of trees with arable crops or pastures/grasses matching the land capability help the farmers of dry regions in imparting stability and providing sustainability to the farming system. Alternate land use system could be possible through Agroforestry which is need of the hour for mitigating the problems in dry lands. It aims at matching the land capacity in the minimum risk and maximum generation of income through efficient utilization of resources. The main aim of agroforestry in dry lands is to improve the site and to optimize the productivity of agricultural crops as well as forest crops (Young, 1997). Well designed Agroforestry systems can contribute to the improvement of rural welfare through a variety of direct " Production roles " *i.e.* food, fodder, fuel, fiber and small timber etc., as well as through whole range of indirect " Service roles " *i.e.* soil and water conservation, fertility improvement, microclimate amelioration etc.

MATERIALS AND METHODS

Different agroforestry systems *viz.*, Agrisilviculture and Agrihorticulture system was followed in red sandy loams soils of Student Farm and Agroforestry Research Blocks of ANGR Agricultural University, Rajendranagar, Hyderabad, A.P. In agrisilviculture system *Hardwickia binata* (8 years old) with sunflower, cowpea, field beans soyabean, ground nut as *kharif* crops and *Faidherbia albida* (13 years old) with maize as *rabi* crop was grown. The experiment was conducted during 2006-2007 with field crops as inter crops in between trees. In another agroforestry practice two agri silvi horti system was conducted with Guava + Curry leaf with soyabean as intercrop in *kharif* and another with Tamarind + Curry leaf + Custard apple with Jowar, cow pea, red gram as inter crops in *kharif* season. The initial and final soil samples were analyzed for soil properties and nutrient status as per standard procedures (AOAC, 1980 and Wilde *et al.* 1972).

RESULTS AND DISCUSSION

The results obtained from the present investigation have been presented in the following sub heads:

Agroforestry practice for crop improvement in poor and marginal soils :

Sunflower when cropped in *Hardwickia binata* after stylo grown for a period of three years recorded higher seed yields than sunflower intercropped after follow in *Hardwickia binata*. The total monetary returns from tree and crop considerably were found higher in intercropped sunflower grown in Hardwickia when compared to sole cropped sunflower. This was mainly due to considering the expected returns from the tree at their particular age from the value added products like fuel, pole etc., from trees (Table 1).

From the study conducted in *Faidherbia albida* cropping system during 2001 in 13 years old plantation and the data presented in Table 2 revealed that the seed yield of maize when grown as intercrop in *Faidherbia albida* was markedly increased when compared to that of sole cropped maize without trees. However, the maize equivalent yields of maize with combination of cow pea, field bean, soyabean and groundnut grown in *Faidherbia albida* were also found higher than that of sole cropped maize. Total net monetary returns from the system (tree + crop) were increased considerably when maize grown alone or in combination with legume crops in *Faidherbia albida* over maize grown as sole crop. The increased monetary returns maize based cropping system in association with trees were mainly due to complimentary effect of trees for crop growth coupled with additional income obtained from the tree products like small timber wood, fuel wood etc. It was clearly evident from the results that the nitrogen fixing trees like *Hardwickia binata*, Faidherbia albida etc., would benefit the dry land farmer in improvement of economic status when grown along with crops in different ways like site enrichment, crop productivity improvement, provision of wide range products (fuel, fodder, green manure, small timber etc.) and finally additional income from the trees.

Table 1 : Seed yield and total net returns from sunflower intercropped with *Hardwickia binata*

Cropping systems	Seed yield (kg ha^{-1})	Total net returns (Rs. ha^{-1})
Sole cropping of sunflower	636	4,134
Inter cropping of sunflower after stylo in Hardwickia	342	6,593
Inter cropping of sunflower after fallow in Hardwickia	248	5,287

Table 2: Maize equivalent yield and total net returns from the system in *Faidherbia albida* based agri silvi culture system

Cropping systems	Maize equivalent yield (q ha^{-1})	Total net returns (Rs. ha^{-1})
Maize alone with trees	26.6	10,301
Maize + Cowpea with trees	25.6	8,891
Maize + Field bean with trees	29.2	10,126
Maize + Soybean with trees	29.4	11,276
Maize + Groundnut with trees	21.0	6,715
Sole Maize without trees	16.7	3,764

Agroforestry practice for economic gain in medium and deep soils :

The field study conducted during 2002 in agri silvi horticulture in five years old guava and curry leaf plantations revealed that the seed yield of soyabean when grown as intercrop either in guava or curry leaf (filler plants) plantation was comparable with that of sole cropping of soyabean (Table 3). Whereas the total net returns obtained from the system (tree + crop) was found maximum under intercropping of soyabean in curry leaf increased the total net returns from the system in comparison with soyabean grown sole crop without trees.

Table 3 : Seed yield of soyabean and total net returns from the system in guava and curry leaf based Agrihorticulture system

Cropping systems	Seed yield (kg ha^{-1})	Total net returns (Rs. ha^{-1})
Sole cropping of soybean	800	3,269
Inter cropping of soybean in guava	739	8,021
Inter cropping of soybean in curry leaf	740	4,845

Hence, integration of fruit or economically important trees with arable crops is intended to maximum land use efficiency to generate supplement income to medium level farmers in semi arid tropics.

Another field trail on agri silvi horticulture system was conducted during kharif 2007, reported (Table 4) that maximum pod yield of tamarind (22.1 q ha^{-1}) was recorded in Tamarind + Curry leaf + Jowar cropping system which was followed by Tamarind + Curry leaf + cowpea (21.7 q ha^{-1}) and Tamarind + Custard apple (filler plant) + Jowar (21.7 q ha^{-1}) cropping systems. Maximum and minimum net returns were recorded in Tamarind + Custard apple + Red gram (Rs 29,972) and Tamarind + Curry leaf + Cow pea (Rs 12,866), respectively.

Agroforestry practices for soil improvement :

Studies on the effect of land use systems on physical properties and nutrient status of soil revealed that the bulk density of soil was reduced in surface and subsurface soils in all the tree based cropping systems compared to fallow (1.61 and 1.68 (Mg kg^{-1}) and agricultural lands (1.62 and 1.67 Mg kg^{-1}) lowest being in Eucalyptus system (Thyagaraj *et al.* 2010). This might be due to better spread and penetration of root system as well as porous nature of soil in rhizosphere. While water holding capacity and infiltration rate were increased compared to fallow and agricultural land system. Maximum water holding capacity and infiltration rate was found in agri-horticultural system (30 and 30% at 0-15 and 15-30 cm and 2.1 cm hr^{-1} at 30 cm depth, respectively) and minimum water holding capacity and infiltration rate was recorded in fallow land use system at both soil depths being 15 and 10% at 0-15 and 15-30 cm and 2.1 cm hr^{-1} at 0-30 cm depth respectively (Thyagaraj *et al.* 2004 and Nagendar Rao *et al.* 2010). This is ascribed to better soil aggregates and improvement in soil structure which coincides with low bulk density values in corresponding system. The percentage of total nitrogen and carbon was increased considerably in the soil covered with tree plantation when compared to fallow and agricultural lands. Maximum total nitrogen (0.076 and 0.071% and total carbon (0.89 and 0.76 % at both depths respectively) was resulted in agri-horticultural system followed by silvi pastoral system being 0.067, 0.064 %

Table 4 : Gross returns and B: C ratio in tamarind based agri-silvi-horti system (2003-2008)

Treatments	Cost of cultivation Tamarind + Custard apple (Rs ha^{-1})	Cost of cultivation of Intercrops (Rs ha^{-1})	Gross returns Tamarind + Custard apple (Rs ha^{-1})	Returns of Intercrops (Rs ha^{-1})	Total cost of cultivation (Tree + Crops) (Rs ha^{-1})	Total Gross returns (Rs ha^{-1})	Total net returns (Rs ha^{-1})	Benefit Cost ratio (Rs ha^{-1})
Tamarind + Custard apple + Red gram	4,000	11,000	19,172	25,800	15,000	44,972	29,972	1.99
Tamarind + Custard apple + Jowar	4,000	11,000	20,592	18,070	15,000	38,662	23,662	1.58
Tamarind + Custard apple + Cowpea	4,000	8,800	21,070	9,200	12,800	30,270	17,470	1.36
Tamarind + Custard apple + Cluster bean	4,000	8,200	16,840	14,700	12,200	31540	19,340	1.59
Mean	4,000	9,750	19,419	16,943	13,750	36,361	22,611	-
Tamarind + Curry leaf + Red gram	3,250	11,000	18,892	12,200	14,400	31,092	16,692	1.16
Tamarind + Curry leaf + Jowar	3,250	11,000	17,450	18,400	14,400	35,910	21,510	1.49
Tamarind + Curry leaf + Cowpea	3,250	8,600	15,926	8,940	12,000	24,866	12,866	1.07
Tamarind + Curry leaf + Cluster bean	3,250	9,000	19,454	16,710	12,400	36,164	23,764	1.92
Mean	3,250	9,900	17,931	14,078	13,300	32,008	18,708	-

Table 5: Influence of different land use systems on soil properties and nutrient status

Land use system	Bulk density ($mg\ kg^{-1}$)		Water holding capacity (%)		Infiltration rate ($cm\ hr^{-1}$)	Total nitrogen (%)		Total carbon (%)		C:N Ratio	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
Fallow land	1.65	1.68	15	10	2.8	0.021	0.017	0.21	0.20	10.1	12.1
Agricultural land	1.62	1.67	18	20	2.9	0.039	0.036	0.42	0.38	11.1	11.1
Agri-silvi system	1.51	1.70	25	20	2.3	0.042	0.034	0.51	0.40	12.2	11.8
Silvi-Pastoral system	1.42	1.60	30	28	1.8	0.067	0.064	0.76	0.71	11.1	11.1
Agri-Silvi-Horti system	1.51	1.55	28	21	2.0	0.065	0.062	0.72	0.70	11.1	10.1
Agri-Horti system	1.48	1.59	30	30	2.1	0.076	0.071	0.89	0.76	12.1	10.1
Eucalyptus	1.38	1.42	30	21	1.6	0.051	0.042	0.59	0.49	11.1	11.1
Faidherbia albida	1.55	1.62	27	19	1.6	0.054	0.049	0.68	0.58	12.1	12.1

and 0.72, 0.70%. This might be due to better decomposition of leaf litter as well as availablibity of nutrients from both system (Sanjeeva Reddy *et al.,* 2010).

Agroforestry, by virtue of inclusion of perennials and herbaceous plants in the same land management unit, can provide multitude of products and services, can help the resource poor farmers to improve productivity and meet the rural needs like fuel, fodder, small timber, green manure etc., thus act as a rural livelihood security.

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LITERATURE CITED

A.O.A.C. (1980). Association of official agricultural chemists. Washington, D.C.

Deswal, A.K. and Nandal, D.P.S. (2008). Growth and yield of wheat (*Triticum aestvum*) under varying levels of irrigation and fertilizer in Eucalyptus based agri silvi culture system. *Indian J. Agroforestry*., **10** (1): 10-14.

Nagendar Rao, C., Prabhu, Prasadini and Sreemanarayana, B. (2010). Infiltration characteristics of red sandy loams under different land use systems. *Indian J. Dryland agric. Res. & Development*, **24** (2): 59-65.

Raturi, G.B. and Hiwale, S.S. (1993). Horti-silvi-pastoral system for increased productivity of marginal and degraded lands under rainfed conditions. *Adv. Hort. & Forestry*, **3**: 179-186.

Sanjeeva Reddy, N., Ramesh, G. and Sreemanarayana, B. (2009). Evaluation of various tree species under different land use systems for higher carbon sequestration. *Indian J. Dryland agric. Res. & Development*, **24** (2): 74-78.

Sharma, K.K., Khanna, P. and Gulati, A. (1996). The growth and yield of wheat and paddy as influenced by *Dalbergia sissoo*. Roxb. boundary plantation. *Indian Forester,* **122** : 1114-1126.

Sumanta, Kundu, Gajbhije, P.N., Srinivasa Rao, Ch. and Bheemaiah, G. (2010). Effect of Integrated nutrient management on yield attributes, yield, nutrient uptake and economics of growing maize in Tamarind-based cropping system. *Indian J. Dryland agric. Res. & Development*, **24** (1): 81-86.

Thyagaraj, C.R. (2004). Interaction influence of tillage time, method and rainfall on soil moisture retention with relevant expert system. Ph.D. Thesis, JNT University, Hyderabad (A.P.).

Thyagaraj, C.R., Srinivas, I. Sanjeeva Reddy, B., Rao, K.V., Vital, K.P. R. and Rao, B.V. (2010). Influence of tillage time, implement and rainfall on soil moisture retention and bulk density in Alfisols. *Indian J. Dryland agric. Res. & Development*., **24** (2): 59-65.

Wilde, S.A., Gorney, R.B., Iyer, I.G. and Voiget, G.K, (1972). Soil and plant analysis for tree culture. Oxford & IBH Publishers., New Delhi.

Young, A. (1997). Agroforestry for soil management, 2nd Ed. Cab International Wallingford (U.K).

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