

Comparative Efficacy of Model Agroforestry Systems Under Dryland Situations

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Abstract: An experiment was conducted during kharif seasons 2005 & 2006 on red sandy loam soils to study the production potential of model agroforestry systems in drylands under tree management practices. Pod yields of groundnut were found increased under intercropping of groundnut in pollarded hardwickia trees when compared to groundnut grown as intercrop either in nutritioined or unnutritioined guava. Substantial reduction in pod yield of groundnut was recorded in intercropping of groundnut in unpollarded hardwickia trees. The total monetary returns from the system (tree + crop) were maximum in intercropping of groundnut in guava plantation resulting higher Profit rupee investment when compared to groundnut grown either as intercrop in hardwickia plantations or as solecrop. LER / IER were found increased in intercropping of groundnut in pollarded hardwickia when compared to intercropping of groundnut in guava plantation.

Keywords: Guava, Hardwickia, Intercropping, Solecropping.

INTRODUCTION

Arid and semiarid lands of India are characterized by frangible environmental conditions and poor productivity. Improvement and advancement in rainfed cropping is crucial to Indian agriculture, because of erratic behaviour of precipitation affecting the productivity. The major constraints that limit crop production in these areas are moisture stress and nutrient stress. Fodder, fuel and small timber which are the primary requirements of farmers are also scarce. Most of the soils in tropical region are low in organic matter.

In view of the diversity of problems or pressures, an integrated approach of land management utilizing the natural resources more efficiently in rainfed areas is essential to meet the requirements of farmers and livestock without deteriorating the land productivity apart from generating stable and continuous income.

In rainfed regions arable crop production is uncertain mainly due to recurring droughts and

other inherent factors. It has been established that alternate land use interventions for these regions have been good ameliorative measures. One of the need based alternate land use system replacing the traditional farming system is tree crop integrated system i.e. agroforestry. The goal of deliberate use of trees in agroforestry is to increase the effectiveness of land for productivity, stability and sustainability of land use for small and marginal farmers of dry regions. Importance of agroforestry in stabilization of income besides protection of environment emphasized (1).

Integration of fruit/economically important trees with agricultural crops provides stability in production in adverse climatic conditions when agricultural crops fail (2). Keeping in view of the importance of agroforestry comprehensive studies on production potential of model agroforestry systems in drylands were carried out during kharif seasons of 2005 and 2006 to assess the production efficiency of different tree based cropping systems in drylands.

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MATERIALS AND METHODS

The field experiment was carried out during *kharif* seasons of 2005 and 2006 at Students' Farm of College of Agriculture, Rajendranagar, Hyderabad. The experiment was laid out in split plot design with three replications. The soil of experiment site was red sandy loam in texture and belongs to order alfisols, medium in organic carbon, available N, available P and available K in the tree plantations of guava and hardwickia, where as in open area (treeless) the soil was low in organic carbon and available N and medium in available P and available K. The field investigation consisted of two agroforestry models *i.e.* guava based agrihorticultural system and hardwickia based agrisilvicultural system.

In guava based agrihorticultural system three cropping situations were studied *viz.*, intercropping of groundnut in nutritioned guava, intercropping of groundnut in unnutritioned guava, solecropping of groundnut. Eight year old guava trees were fertilized with 210 g N, 160 g P₂O₅ and 300 g K₂O and 60 kg FYM per tree under the treatment of nutritioned guava during both the years of study. Similarly in hardwickia based agr-silvicultural system also three cropping situations were studied *viz.*, intercropping of groundnut in pollarded

hardwickia, intercropping of groundnut in unpollarded hardwickia, solecropping of groundnut. The stems of hardwickia trees were cut above 3 m height from the base of ground at 15 days before sowing of crop under the treatment of pollarded hardwickia in both the years of study. The groundnut variety (TMV-2) was selected as intercrop component and sown in first and second week of July during 2005 and 2006 respectively in the interspaces of guava plantation, hardwickia plantation and openarea as solecropping. For comparison sake, the mean values of pod yield of groundnut obtained in both the years of study were presented in table.

Monetary returns from the system (tree + crop) were presented as total gross and net monetary returns from the system, and per rupee investment from the system by taking the estimated returns from the trees and monetary returns obtained from the crop under intercropping situation both in guava as well as hardwickia plantations.

To assess the advantages in terms of area, time, yield and income Land Equivalent Ratio (LER) / Income Equivalent Ratio (IER) were worked out in the agroforestry system as per the procedure (3).

$$\text{LER/IER} : C_i/C_s + T_i/T_s$$

Table 1
Comparative efficacy of model agroforestry systems (2005 and 2006)

	Groundnut pod yield (kg ha ⁻¹)			Total gross returns from system (Rs ha ⁻¹)			Total net returns from system (Rs ha ⁻¹)			Profit per rupee investment from systems			LER/IER		
	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean	2005	2006	Mean
<i>Agrihorticultural system</i>															
ING	656.90	521.24	589.07	36241	33392	34817	25405	22756	24081	2.40	2.19	2.30	1.68	1.58	1.63
IUNG	629.42	509.50	569.46	26065	23550	24808	18029	15713	16871	2.34	2.10	2.22	1.65	1.57	1.61
SC	948.23	875.13	911.68	19913	18378	19146	11876	10541	11209	1.55	1.41	1.48	-	-	-
<i>Agrisilvicultural system</i>															
IPH	785.31	683.57	734.44	23081	20945	22013	14544	12609	13577	1.76	1.37	1.57	1.82	1.77	1.80
IUPH	393.55	384.17	388.86	14855	14658	14757	6818	6821	6820	0.89	0.93	0.91	1.41	1.43	1.42
SC	948.23	875.13	911.68	19913	18378	19146	11876	10541	11209	1.55	1.41	1.48	-	-	-

ING - Intercropping in nutritioned guava, IPH - Intercropping in pollarded hardwickia

IUNG - Intercropping in unnutritioned guava, IUPH - Intercropping in unpollarded hardwickia

SC - Solecropping

Where, C_i : Yield/income of crop under intercropping situation

C_s : Yield/income of crop under solecropping situation

T_i : Yield/income of tree under intercropping situation

T_s : Yield/income of tree under solecropping situation

LER/IER of trees is taken as 1, since there was no difference in the yield or income of tree both as inter crop tree or sole tree, hence it is expressed as LER/IER.

RESULTS AND DISCUSSION

Pod Yield

The relative yield performance of groundnut crop revealed that in agrihorticultural system, a considerable reduction was observed in pod yield of groundnut when grown as intercrop either in guava plantations or hardwickia plantations when compared to solecropping of groundnut. Among the intercropping situations studied both in guava and hardwickia plantations, substantial increase in pod yield of groundnut was obtained in intercropping of groundnut in pollarded hardwickia. Whereas, intercropping of groundnut in unpollarded hardwickia recorded substantial reduction in pod yield of groundnut when compared to the intercropping situations both in guava and pollarded hardwickia plantations during both the years of study. It was clearly evident from both the agroforestry systems studied that the pod yields of groundnut were found increased under intercropping of groundnut in pollarded hardwickia trees when compared to intercropping of groundnut in nutritioned guava as well as unnutritioned guava, because of more area accommodated for cropping in hardwickia plantations coupled with abundant light availability to the crop. The substantial decrease in pod yields of groundnut when grown as intercrop in unpollarded hardwickia trees due to canopy spread of hardwickia trees in unpollarded conditions which interrupted the light transmission to the crop grown underneath. Similar results were obtained by (4,5,6).

Total Monetary Returns from the System

The total monetary returns in terms of gross and net returns were found increased to the maximum under intercropping of groundnut in nutritioned guava which was followed by intercropping of groundnut in unnutritioned guava when compared to that obtained in solecropping as well as in intercropping of groundnut in hardwickia plantations during both the years of study. However, intercropping of groundnut in pollarded hardwickia proved to be better in enhancement of total monetary returns from the system both in gross and net returns when compared to that obtaining in solecropping of groundnut in both the years. Whereas intercropping of groundnut in unpollarded hardwickia recorded substantial reduction in both gross and net monetary returns from the system when compared to all other cropping situations during both the years of study. Higher monetary returns in guava based agrihorticultural system could be attributed to the commercial market price value of fruits of guava when compared to the price values of poles, fuel wood and fodder etc. of hardwickia trees. These findings are in conformity with the finding of (7,8).

Profit Per Rupee Investment

The highest profit per rupee investment was recorded under intercropping of groundnut in nutritioned guava which was followed by intercropping of groundnut in unnutritioned guava in agrihorticultural system when compared to intercropping of groundnut in hardwickia as well as solecropping of groundnut in both the years of study. Intercropping of groundnut in pollarded hardwickia in agrisilvicultural system also gave higher profit per rupee investment when compared to solecropping of groundnut in both the years. But profit per rupee investment was found less in intercropping of groundnut in unpollarded hardwickia when compared to solecropping of groundnut in both the years of study. Increased profit per rupee investment in guava based agrihorticultural system was mainly due to commercial market value of guava fruits coupled with reasonable production of groundnut crop when grown in association with fruit trees. Better

response in profit per rupee investment when groundnut grown in pollarded hardwickia trees was mainly due to value added products like poles, fuel and fodder coupled with good amount of pod yield obtained from intercrop groundnut in hardwickia based agrisilvicultural system. The reduction in profit per rupee investment from groundnut crop when grown as an intercrop in unpollarded hardwickia trees could be attributed to drastic reduction in pod yield. These findings are in conformity with the finding of (8).

Land Equivalent Ratio (LER)/Income Equivalent Ratio (IER)

The highest value of LER/IER was recorded in intercropping of groundnut in pollarded hardwickia in agrisilvicultural system in both the years of study. Whereas in agrihorticultural system intercropping of groundnut either in nutritioned guava or unnutritioned guava did not show much variation in LER/IER values, but proved to be effective in increasing the LER/IER values when compared to the values recorded under intercropping of groundnut in unpollarded hardwickia during both the years of study. Higher values of LER / IER recorded with intercropped groundnut in pollarded hardwickia trees in agrisilvicultural system was mainly due to increased pod yields coupled with less cost of management of hardwickia trees when compared to intercropping situations in agrihorticultural system. These results are in agreement with (6, 9).

It is apparent from the results of the present study on two agroforestry models (guava based agrihorticultural system and hardwickia based agrisilvicultural system) that the guava based agrihorticultural system with groundnut as an intercrop proved to be economically viable and more profit oriented system because the main product of fruit trees is the market valued component. In addition to the returns from the fruit trees, the returns from the intercropped groundnut

was considered as bonus in the event of success of intercrop during the adequate rainfall year when compared to hardwickia based agrisilvicultural system.

Hence, it is worthwhile to adopt the practice of tree based cropping systems either agrihorticultural system or agrisilvicultural system depending on type of farmer which would help in improvement of rural livelihood by providing multitude of products and services to the poor and marginal farmer in SAT areas.

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