Agri-silvi-pastoral System for Conservation of Natural Resources in Rainfed Areas of Bihar

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ABSTRACT: *Field studies were conducted during 2004-2007 under the sub-humid subtropics at Patna on Agri-silvi-pastoral system for conservation of natural resources in rainfed areas of Bihar. Subabul when intercropped with guinea grass + cowpea/ fieldpea/cowpea during Kharif, Rabi and summer respectively yielded maximum with a fodder and fuel wood yield of 44 and 4.8 tonnes/ha/year respectively and 2 t/ha of pod yield of green field pea for human consumption. However, sole subabul gave 3.0 and 6.0 tonnes/ha/year and fuel yield respectively.*

Keywords: Multipurpose trees, Cowpea, Guinea grass, Field pea.

INTRODUCTION

There is a rapid deterioration in soil fertility due to insufficient addition of organic matter in agricultural lands of Bihar. The state has 0.48 lakh ha of cultivable wastelands, 1.14 lakh ha of fallow lands and current fallows of 5.95 lakh ha which are lying unutilized. The proportion of forest in the state is much lower (6.35 per cent) than the standard fixed for maintaining ecological balance (30 per cent). It has been estimated that by judicious planning an additional 1.71 m ha may be put under tree cover. Action plan recommended by Rajendra Agricultural University under planning commission of GOI, has stressed on wastelands utilization by silvi-culture through Panchayati Raj bodies or by individuals. Annually there is a shortage of 30 million tones of green fodder in Bihar. Planting of multipurpose trees with grasses and legumes in an integrated system of cultivation and environmental conservation in Bihar under rainfed situations. Therefore a 4 year trial was conducted to identify compatible tree-grass-legume combinations for improving overall forage, legumes and tree crop productivity and soil fertility of the rainfed uplands.

MATERIAL AND METHODS

A four year agri-silvi-pastoral field trial was conducted in silty clay loam soils during 2004-2007 at WALMI farm of ICAR-RCER, Patna. The top 60 cm soil of the field trial was silty clay loam in texture with pH-7.0, bulk density 1.48 $g^{-1}cc$, particle density 2.72 $g^{-1}cc$, Organic carbon 0.65% and medium in available N (274 kg ha^{-1}), high in available phosphorus (31 kg ha^{-1}) and rich in available K_2O (340 kg ha^{-1}).

Seven treatments viz., T_1- Subabul (*Leucaena leucocephala)* 2 rows at 3x3 m, T_2-Gumhar (*Gmelina arborea*) 1 row at 6x6m,, T_3- Safed siris (*Albigia procera*) 1 row at 6x6m, T_4- Subabul + companion crop, T_5- Gumhar + Companion crop, T_6- Safed siris + Companion crop and T_7- Sole crop were maintained with 3 replications under Randomized Block Design. Companion crops included one perennial grass viz., Guinea grass (*Panicum maximum*) planted at 1 m X 0.5 m spacing. During rainy and summer seasons-Cowpea variety Bundel 1 was grown. During winter season-Field pea variety Aparna was sown as intercrop in the interspaces of the Guinea grass.

The treatments were maintained continuously by reseeding/planting of desirable trees, grasses and legumes in integrated manner and their utilization under cut and carry system. Height of the standing tree as measured from ground level to the crown point was considered as an index of fertility. The biometric observations were recorded periodically. The basal diameter and diameter at breast height of trees at 36 months were also recorded.

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Table 1
Biometric Observations of Trees at 36 Months

Treatments	Tree Height (m)	Basal diameter (cm)	Diameter at breast height (cm)
Subabul	5.33	25.2	15.2
Subabul + companion crop	5.11	26.6	13.4
Gumhar	3.95	28.8	11.5
Gumhar + Companion crop	2.15	15.2	8.0
Safed Siris	4.22	31.0	13.4
Safed Siris + Companion crop	2.35	16.7	9.7

RESULTS AND DISCUSSION

The subabul attained the maximum height (5.33 m) followed by safed siris (4.22 m). Similar findings were also reported by Devaranavadgi *et al.*, (2003). Gumhar had shortest plants (3.95 m). Highest basal diameter was recorded by Safed siris (31.0 cm) followed by that of Gumhar (28.8 cm). It was lowest in Subabul (25.2 cm). The diameter at breast height was maximum in Subabul (15.2) followed by Safed siris (13.4). It was lowest in Gumhar (11.5). The results indicated that subabul when intercropped with guinea grass + cowpea/field pea/cowpea during Kharif, Rabi and summer respectively yielded maximum with a fodder and fuel wood yield of 45.3 and 5.6 tonnes/ha/year respectively and 0.2 t/ha of pod yield of green field pea for human consumption. However, sole subabul gave 3.5 and 6.6 tonnes/ha/year of fodder and fuel yield respectively (Table 2).

Table 2
Fodder/Fuel Yields Under Different Treatments of Agri-silvi-pastoral System

Treatments	Fresh fodder (t/ha)	Fuel wood (t/ha)	Green pods (t/ha)
Subabul	3.5	6.6	-
Gumhar	2.5	4.8	-
Safed Siris	3.5	5.7	-
Subabul + Companion crop	45.3	5.6	0.2
Gumhar + Companion crop	39.0	3.1	175
Safed Siris + Companion crop	42.5	4.6	185
Sole crop	38.2	-	194
CD (P = 0.05%)	6.6	0.66	28

The soil fertility changes as a result of maintenance of agri-silvi-pastoral system are presented in Table 3. It is seen that organic carbon content of soil was higher in subabul pure tree than other trees. This may be attributed to addition of litterfall, root density and other organic materials contributed by subabul. The highest increase in available nitrogen in soil (14 kg/ha) was recorded with subabul + companion crop. Increase in available nitrogen in the available pool of the soil may be attributed to the direct addition of nitrogen residues

Table3
Changes in Soil Fertility Due to Introduction of Agri-silvi-pastoral System

	pH 1: 2 solution		Organic carbon (%)		Available Nitrogen (kg/ha)		Available phosphorus (kg/ha)		Available potash (kg/ha)	
Treatments	Initial	After 3 years	Initial	After 3 years	Initial	After 3 years	Initial	After 3 years	Initial years	After 3
Subabul	7.66	7.5	0.72	0.90	280	287	35	40	400	411
Gumhar	8.41	8.37	0.65	0.72	275	288	32	37	350	362
Safed Siris	7.86	7.8	0.66	0.74	280	290	34	38	380	402
Subabul + Companion crop	7.64	7.6	0.73	0.80	281	295	34	38	410	422
Gumhar + Companion crop	8.43	8.40	0.66	0.72	282	290	38	40	405	415
Safed Siris + Companion crop	7.86	7.82	0.67	0.75	283	292	36	39	403	411
Sole crop	7.82	7.80	0.65	0.72	284	288	39	41	400	405

of companion crop and subabul. The favourable soil conditions due to N addition of subabul might have helped in the mineralization of soil N leading to build up of higher available N. Higher addition of organic matter through subabul also helped in releasing the higher amounts of phosphorus from the soil. Available potash was maximum in case of safed siris followed by Gumhar and Subabul since nutrients addition in the soil through litter fall largely depend on the tree species, quantity and quality of litter and the ease with which it is decomposed in the soil.

Agri-silvi-pastoral system holds potential for sustenance of agriculture, as this system provides food, fodder, fuel wood, etc. from the same piece of land. It is not only fulfill the demand of people for fuel and fodder but can also elevate their socio-economic status.

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