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Productivity, response to nitrogen and nutrient cycling of sole jatropha (*Jatropha curcas*) and intercropping system with baby corn (*Zea mays*) in India

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ABSTRACT

Sole jatropha (*Jatropha curcas* L.) and intercropped system with baby corn (*Zea mays* L.) were evaluated for productivity, nutrient cycling, and economical viability under four levels of nitrogen at New Delhi, during 2007-09. Baby corn as intercrop under the 3-4 years old jatropha canopy received 65-70% of solar radiation during its growth period from February to April. Three rows of baby corn between the two rows of Jatropha interspaced at 3.0 m, recorded 819 and 765 kg baby corn yield/ha during 2007 and 2008. Sole and intercropped baby corn responded up to 80 kg N/ha. Sole jatropha recorded significantly higher seed yield (2.48 Mg/ha) than intercropped stand (2.23 Mg/ ha). Jatropha responded up to 40 kg N/ha in sole and 80 kg N/ha in intercropped stand. Based on two years mean, intercropped stand recorded an increase of 135% in productivity and 54% in land equivalent ratio as compared to sole Jatropha. Weed population and dry weight were found significantly low in intercropped stand. Jatropha produced 6 Mg/ha/year litter, which recycled 44.0 kg N, 7.4 kg P and 38.4 kg K/ha/year. At the termination of experiment, soil organic C in 0–15 cm soil depth in sole Jatropha (0.48%) and Jatropha + baby corn (0.49%) was found higher over the initial value (0.43). Conspicuous reduction in soil pH (7.4) and soil bulk density (1.46) were recorded compared to initial values (7.8 and 1.50). Water holding capacity of soil also recorded improvement over initial values.

Key words: Jatropha-baby corn intercropping, Litter fall, N management, Nutrient cycling, Soil properties.

Energy independence through renewable and green fuels is one of the vital areas to make India a developed nation. Among different types of alternate sources of energy, bio-energy through plant route is considered very promising, because of its eco-friendly and renewable nature. Jatropha (*Jatropha curcas* L.) cultivation is being promoted for production of biodiesel (Kureel 2007; Rana 2007; Wani and Sreedevi 2007)

Being a wild plant, reliable statistics pertaining to productivity and economics of Jatropha production is not available. Jatropha germplasm used for plantation is poor yielder and its yield ranges from 1-3 Mg/ha. Similarly, oil content in the seed varies from 30-40%, of which recovery is 20-30% (Wani and Sreedevi 2007). Maize for baby corn is very remunerative and can be grown during spring season in areas, where two to three irri gations are available. Under-storey cropping in tree/shrub plantation at appropriate period during the year can efficiently utilize land and labour, resources and make the plantation economically sustainable (Korwar *et al.* 2006, Miller and Pallardy 2001, Raddad *et al.* 2006).

Information on N requirement of Jatropha and baby corn intercropping system is not available and therefore an experiment in 4 years old plantation of Jatropha was taken-up during 2007-08 and 2008-09 to compare the productivity of Jatropha and baby corn in sole and intercropped stand, find out N requirement of Jatropha and baby corn in sole and intercropped stand, quantify the litter fall of Jatropha and nutrient recycling through it and assess the changes in soil health due to Jatropha plantation and agri-silviculture system.

MATERIALS AND METHODS

A field experiment was conducted during 2007-08 and 2008-09 at the experimental farm of the Indian Agricultural Research Institute, New Delhi, India. The experimental site is located in the Indo-Gangetic alluvial tract at 28°40′ N and 77°12′ E, at an altitude of 228 m above mean sea level. The climate of the region is sub-tropical, semi-arid. The area receives an annual rainfall of 652 mm, about 80% of which occurs from June to September. The mean maximum and minimum temperatures are 35 and 18°C from July to October and 22.6 and 6.7°C from November to April, respectively. The alluvial soil of experimental site was sandy loam in texture and had a bulk density of 1.50 Mg/ m, pH (1:2 soil: water) of 7.8, electrical conductivity of 0.46 dS/m, CEC of 7.3 C mol (p^+) kg/ha; and available N, P and K were 245, 12.8 and 195 kg/ha, respectively. These physical and chemicals properties of soil were measured at the time of plantation of Jatropha in July 2003 following standard procedures as well as determined at the end of

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experiment by following the standard procedure as given in.

Jatropha plantation was done at the Institute farm under the mega-multi-disciplinary project entitled "Development of bio-fuels for energy security and environmental protection". Four months old saplings of Jatropha were transplanted in pits of 45 × 45 × 45 cm dimension by mixing 2 kg FYM in each pit. Saplings were transplanted at four spacing of 2 × 2, 2.5 × 2.0, 3.0 × 2.0 and 3.0 × 3.0 m resulting in a plant density of 2500, 2000, 1666 and 1111 plants/ha. A series of experiments were conducted on intercropping, pruning, nutrient and water management and changes in soil health.

The experiment was conducted in 3.0 × 2.0 m planting geometry, in a three times replicated split-split-plot design. Three cropping systems, viz. sole Jatropha, Jatropha+baby corn and sole baby corn were considered as main plots, baby corn varieties, viz. Pusa Early Hybrid Maize (PEHM-2) and Pusa Composite (PC 2) were allotted in sub-plots and 4 N levels, viz 0, 40, 80 and 100 kg/N in sub-sub-plots. A replication block consists of nine rows of Jatropha plants with 9 plants in each row. Each block of replication received treatments of system. In sole stand and intercropped stand of each variety seven plants of Jatropha were used to record observations, while in each sub-sub plot one plant of Jatropha was used to record observations to find out the effect of graded level of N. Sole baby corn was grown in the adjoining field. Each replication of baby corn was divided into two sub-plots of 3.0 × 15.0 meter dimension to adjust two variety of baby corn. Each sub-plot further divided into four sub-sub plots of 3.0 × 3.0 meter dimension to adjust four levels of N.

Intercropping system was created by sowing 3 rows of baby corn (interspaced at 50 cm), in the three meter wide strip between the two rows of Jatropha. Intercropped baby corn strip row was one meter away from Jatropha row, thus based on row spacing; baby corn occupied 50% of the total area between the two rows of Jatropha N as per treatment was applied at the rate of 40, 80 and 120 kg/ha along with control in sole baby corn, sole Jatropha and Jatropha + baby corn. In sole baby corn and Jatropha+baby corn half of N as per treatment was given at the time of sowing of baby corn while remaining half dose was given at 35 days after sowing. In Jatropha+baby corn system N dose calculation was done based on the total area occupied by the system but its application was restricted to strip occupied by baby corn between two rows of Jatropha. So in intercropped stand on the basis of cropped area, baby corn received higher dose of N as compared to sole stand. In sole Jatropha, N as per treatment was given in the first week of July, while in intercropped stand response to residual effect of N applied to baby corn was evaluated.

Two cultivars of baby corn, viz Pusa Early Hybrid Maize (PEHM-2) and Pusa Composite (PC 2) was sown on 18 and 15 February in the respective years, with hand plough after pre-sowing irrigation and pushing the residue away from plough line. Crop was nourished as per recommended cultural practices. Besides pre-sowing irrigation, crop received three irrigations. Baby corn plots were hand weeded at 30 days after sowing of baby corn to control weeds. In Jatropha the weed infestation was very less due to self-shading, so no weeding is required. Baby cobs were harvested in two plucking on 20 and 27 April in 2007 and 17 and 24 April in 2008 of variety PEHM-2 and 30 April and 8 May in 2007 and 28 April and 6 May 2008 of variety PC-2. During the reproductive phase of Jatropha from July to January no irrigation was done.

Number of branches/plant and plant height of Jatropha was recorded for all the selected plants in the experimental area at the end of December 2007 and 2008. For estimation of seed yield/plant, two picking were done from each plant on 15 December and 15 January in respective year. Seed yield/plant over the treatments was used to find out mean seed yield/plant under each treatment and replication. Based on the mean seed yield/plant, seed yield/ha was worked out on the basis of plant population/ha. In case of baby corn, growth and yield attributes such as number of cobs/plant, green cob weight, weight of baby corn and green cob: baby corn ratio were recorded based on randomly selected three plants taken at the time of harvest of the crop. Number of plants/ha, number of cobs/ha, per cent barrenness and baby corn and green fodder yield/ha were worked out on the basis of number of plants/plot and yield/plot and converting it to /ha based on area under each plot. For comparing the system productivity, Jatropha seed equivalent yield of each system was obtained by converting the baby corn/fodder yield into economic value based on the prevailing prices of baby corn/fodder at the local regulated market and converting the economic value into Jatropha seed yield by dividing it by the market price of Jatropha.

Two systems, viz. sole maize and intercropped stand and four levels of N were evaluated for their effect on weeds at 30 days after sowing during the spring season. For evaluating the effect of treatments on weeds, weed population/m was recorded by counting and picking the weeds present inside the quadrate of size 0.5 × 0.5 meter, thrown randomly at two spots in each treatment. Weed population was recorded from sole maize and intercropped stand ignoring the varieties over the N treatments. Weeds were picked up from each quadrate, counted and average of two spots in each treatment was subjected to statistical analysis. There was uniformity in weed population data, so data was not subjected to square root transformation. For weed dry weight estimation, weeds removed from each quadrate were washed, dried in sun and finally dried in the oven at 70^o C till the samples attained constant weight.

Litter fall from Jatropha plants under each treatment was recorded by marking an area of 1m^2 in each plot and collecting leaves and twigs from this area at regular interval of 3 months during 2007 and 2008. Litter fall was first dried in sun and thereafter in oven at 70^o C for 3 days, before taking the dry weight. Average dry weight/m over the treatment was used to work out litter fall/ha. Organic carbon content was taken as 40 per cent of total dry weight of litter fall. For the nutrient recycling through litter fall three replicate of composite samples were drawn and analyzed for N, P and K content by micro-kjeldahl, Vanadomolybdophosphorric yellow colour and flame photometry methods, respectively. N (0.71%), P (0.12%) and K (0.62%) contents so obtained were used to calculate amount of N, P and K recycled through litter fall.

The data collected on different parameters were subjected to appropriate statistical analysis. For litter fall, nutrient recycling, physical and chemical properties of soil and weed studies data was collected and analyzed in split plot design for cropping system and N levels ignoring the sub-plots of genotypes of baby corn. Significance of difference between means was tested through 'F' test and the critical difference was worked out, where variance ratio was found significant for treatment effect. The treatment effects were tested at 5% probability level for their significance

RESULTS AND DISCUSSION

Yield and yield attributes of baby corn

Plants compete for resources irrespective of whether they are grown in sole stands or as species mixture. Productivity of both crop and tree components in agrisilviculture system is generally limited primarily due to water, nutrients and light stress (Vani and Bheemaiah 2003), so a production system that makes optimal use of resources shows the highest productivity. Sole baby corn recorded significantly higher number of plants and cobs/ha compared to its intercropped stand. Sole and intercropped stand of baby corn recorded statistically similar values of number of cobs/plant, green cob weight, baby corn weight, green cob: baby corn ratio and per cent barrenness. PEHM 2 and PC-2 did not show marked variation in numbers of plants/ha, green cob: baby corn ratio and per cent barrenness. With respect to number of cobs/ha, cobs/plants, green cob weight/ plant and baby corn weight/plant, PEHM 2 recorded significantly higher values compared to PC-2. Statistically similar numbers of plants/ha were recorded under different levels of N. With successive increase in N level from control to 120 kg N/ha, significant increase in values of yield attributes of baby corn was recorded up to 80 kg N/ha except percent barrenness, where marked decrease was recorded with successive increase in N up to 80 kg N/ha.

Sole baby corn recorded significantly higher baby corn and green fodder yields/ha than its intercropped stand with Jatropha (Table 1) across the years of study. Reduction in yield under intercropped stand was more in 2008 compared to 2007. On the basis of net area occupied by baby corn in the intercropped stand, i.e. 50% of the sole stand, baby corn yield recovery in intercropped stand was 54.3% in 2007 and 52.4% in 2008 that of the yield recorded in sole stand. PEHM 2 recorded higher baby corn and green fodder yields over PC-2. On the basis of baby corn yield recovery, PC-2 performance was better in intercropped stand than PEHM 2. With the successive increase in N levels, a marked improvement in baby corn yield was recorded up to 80 kg N/ha during both the crop seasons. Contrary to baby corn yield, increase in green fodder yield was significant up to 120 kg N/ha. On two years mean basis, N fertilization @ 40, 80 and 120 kg N/ha recorded an increase of 40.0, 20.4, and 3.5% in baby corn yield and 43.6, 19.6 and 9.3% in green fodder yield over successive level of N application, respectively. N application resulted in marked improvement in baby corn yield recovery under intercropped stand. This improvement in yield recovery was the highest between 0 and 40 kg N/ha, followed by 40 and 80 kg N/ha. Irrespective of this, reduction in baby corn yield under intercropped stand was more in 2008 as compared to 2009.

Table 1 Baby corn and fodder yield as influenced by cropping systems, genotypes and nitrogen level

Treatment	Baby corn yield (kg/ha)		% baby corn yield recovery from 50% area under intercropped stand in relation to sole stand		Maize green fodder yield (Mg/ha)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Planting system						
Sole baby corn	1505	1460	100	100	32.3	30.7
Jatropha+baby corn	819	765	54.3	52.4	16.8	14.0
CD (P = 0.05)	125	105			2.49	2.38
Genotype						
PEHM 2	1173	1127	52.8	50.1	26.3	24.0
PC 2	1151	1097	55.7	54.7	22.6	20.6
CD (P = 0.05)	NS	NS			2.43	2.35
Nitrogen levels (kg/ha)						
0	798	742	49.2	48.2	15.3	15.0
40	1117	1040	55.2	52.9	22.6	20.6
80	1344	1235	56.3	53.4	26.2	25.5
120	1396	1290	56.7	53.5	28.4	28.1
CD (P = 0.05)	118	98			1.96	1.89

Table 2 Growth and yield attributes and seed yield of Jatropha as influenced by cropping systems, genotypes and nitrogen levels

Treatment	Plant height (m)		Number of branches/plant		Seed yield/plant (g)		Seed yield/ha (kg)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Planting system								
Sole baby corn	3.96	5.05	46.5	55.9	1180	1317	1999	2480
Jatropha+baby corn	3.88	4.81	46.7	51.5	1110	1235	1862	2234
CD (P = 0.05)	NS	0.21	NS	3.1	60	70	NS	124
Genotype								
PEHM 2	3.89	4.88	47.0	54.3	1140	1281	1832	2258
PC 2	3.92	4.96	46.2	52.6	1150	1329	1810	2210
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen levels (kg/ha)								
0	3.68	4.74	43.2	49.0	1070	1140	1673	2094
40	3.88	4.94	46.5	52.7	1200	1304	1825	2252
80	4.01	4.99	48.0	55.2	1260	1440	1943	2432
120	4.05	5.02	48.7	57.0	1250	1447	1962	2486
CD (P = 0.05)	0.20	0.18	2.5	2.8	45	50	66	82

Growth and seed yield of Jatropha

Number of branches/plant and plant height of sole Jatropha and intercropped stand of Jatropha were recorded on par at the end of first year of experiment. By the end of second year of experimentation, sole Jatropha recorded marked increase in plant height and branches/plant compared to intercropped stand. In term of per cent, sole Jatropha recorded 5.0% increase in plant height and 8.5% in number of branches/plant over intercropped stand. Baby corn genotype as intercrop with Jatropha failed to induce marked variation in number of branches/plant and plant height of Jatropha. Successive increase in N application to intercropped and sole stands of Jatropha, induced changes in plant height and branches/plant. This increase in growth parameters due to N application was found perceptible at 80 and 120 kg N/ha respectively over control during the first year. This effect of N application on growth parameters got accumulated over the two seasons and by the end of second seasons, N application even at 40 kg N/ha induced marked increase in plant height and number of branches/plant over control (Table 2).

Jatropha in intercropped stand recorded significant reduction in seed yield/plant and /ha compared to sole stand. This decrease in yield was more conspicuous in the second year than in the first year. Baby corn genotypes as intercrop were not found effective in affecting the seed yield/plant and/ha. In sole Jatropha, seed yield/plant and /ha recorded significant increase only up to 40 kg N/ha during both the years. In the intercropped stand, seed yield/plant and /ha responded significantly up to 80 kg N/ha (Table 2). In sole Jatropha, application of 40, 80 and 120 kg N/ha recorded 13.0’ 16.4 and 17.3% increase in seed yield/ha over control during the first year and 16.8, 18.9 and 19.4% in the second year respectively. In the intercropped stand, corresponding increase was 7.8, 20.8 and 26.0% in the first year and 8.4, 18.8 and 22.5% in the second year. Seed yield/plant and/ha of Jatropha irrespective of its stand, recorded at the end of second year experimentation were markedly higher compared to yields recorded at the end of first year experimentation. Cropping system and N levels interacted significantly with respect to seed yield of Jatropha during both the seasons. In the intercropped stand, Jatropha responded up to 80 kg N/ha compared to 40 kg N/ha in sole stand.

Response analysis

Response analysis of N levels with respect to baby corn yield and seed yield of Jatropha was found quadratic in nature. Application of N induced linear increase in the beginning, but with further increase in the level of N, subsequent increase in yield was at decreasing rate, as a result of which, baby corn and Jatropha recorded quadratic response to N application. In baby corn, N use response was better in second year of experiment than first year. Contrary to this, in Jatropha it was better in first year than second year. With the decrease in optimum economic dose (OED), there was an increase in response to kg seed per kg of N applied to maize and Jatropha. It is also inferred from the study that there is no need of separate N application to Jatropha in intercropped stand with maize. Optimum economic dose (OED) of N was far less in sole Jatropha than intercropped stand based on residual effect of N, whereas sole and intercropped baby corn did not showed marked variation in the optimum economic dose of N. Quadratic response to N application in intercropped stand of Jatropha clearly brings out that there is no need of separate application of N to Jatropha over and above given to baby corn.

System productivity

System productivity in terms of Jatropha seed equivalent yield, land equivalent ratio (LER) recorded marked variation due to planting systems. During both the years, sole baby corn and baby corn + Jatropha recorded statistically similar

Table 3 System productivity and economics of Jatropha and baby-corn as influenced by planting system, genotypes and nitrogen levels

Treatment	Jatropha seed equivalent yield (Mg/ha)		Mean LER		
	2007-08	2008-09	Baby corn	*Jatropha*	System
Planting system					
Sole jatropha	1.91	2.44	1.0	1.0	1.0
Sole baby corn	5.28	5.11	1.0	1.0	1.0
Jatropha + baby corn	4.69	4.91	0.60	0.94	1.54
CD (P = 0.05)	1.05	0.98			
Genotype					
PEHM 2	5.95	6.18	0.72	0.94	1.66
PC 2	5.83	6.10	0.73	0.95	1.68
CD (P = 0.05)	NS	NS			
Nitrogen levels (kg/ha)					
0	4.45	4.61	0.72	0.91	1.63
40	5.73	5.93	0.69	0.93	1.62
80	6.63	6.77	0.72	0.94	1.66
120	6.84	6.83	0.76	0.96	1.72
CD (P = 0.05)	0.95	0.82			

Jatropha seed equivalent yield, but both the systems of planting established their superiority over sole Jatropha in term of Jatropha seed equivalent yield. Jatropha + baby corn recorded about 145% increase in Jatropha seed equivalent yield in first year and 101% in the second year over sole Jatropha. This yield advantage from intercropping systems further got evident from LER. Intercropping system recorded 1.54 LER, which indicate 54 per cent saving of land surface through intercropping compared to sole stand. Intercropping of baby corn with Jatropha turned sole cultivation of Jatropha to a highly remunerative enterprise (Table 3). Intercropping of PEHM 2 with Jatropha recorded higher values of Jatropha seed equivalent yield and net return compared to PC-2.

With successive increase in N levels, marked increase in Jatropha seed equivalent yield was recorded up to 80 kg N/ha during both the years of experimentation. LER recorded increasing trend with successive increase in N application, but the increase was found variable over the N levels. Increase in Jatropha seed equivalent yield were the highest between 0 and 40 kg N/ha and the lowest between 80 and 120 kg N/ha. Contrary to this, LER recorded maximum increase between 80 and 120 kg N/ha. Similarly, Papaya intercropped with okra, water melon, sweet potato, bush greens, jews mallow and *Solanum gilo* recorded 3.86, 3.13, 2.06, 1.86, 1.60 and 1.50 LER, respectively (Aiyelaagbe and Jolaoso 1992). They further reported that all the intercropped combination of papaya with different crops were more remunerative than mono crop of papaya.

Litter fall, nutrient recycling and soil health

For understanding ecosystem functioning, the study of the litter fall addition and its contribution in soil organic carbon and nutrient recycling are important. Litter fall of 3 and 4 years old plantation of Jatropha based on two years average was found around 6 Mg/ha (Table 4). Litter fall was more in sole stand than intercropped stand. With two variety of baby corn as intercrop, Jatropha produced similar amount of litter. With the increase in N level, significant increase in litter fall was recorded up to 80 kg N/ha. Litter was found to contain on an average, 0.71% N, 0.12% P and 0.62% K. Based on this content of NPK, litter fall in sole Jatropha was found to recycle 44.0 kg N, 7.4 kg P and 38.4 kg K/ha/year. In Jatropha + baby corn system amount of NPK recycled was significantly low as compared to sole stand of Jatropha (Table 4). Amount of NPK recycled through litter fall increased with successive increase in N level and this increase was significant up to 80 kg N in case of N and K.

Soil organic carbon (SOC) content analyzed at the end

Table 4 Litter fall, nutrient recycling through litter fall of Jatropha and physical and chemical properties of soil as affected by planting systems and nitrogen levels

Treatment	Litter fall# (Mg/ha)	Nutrient recycling through litter fall# (kg/ha)			SOC (%)	Soil pH	Soil bulk density (Mg/m^3)	Water holding capacity (%, w/w)
		N	P	K				
Cropping systems								
Sole Jatropha	6.20	44.0	7.4	38.4	0.48	7.4	1.46	18.4
Sole baby corn					0.42	7.8	1.50	17.2
Jatropha+baby corn	5.88	41.7	7.1	36.4	0.49	7.5	1.46	18.3
CD (P = 0.05)	0.18	1.2	NS	1.8				
Nitrogen levels (kg/ha)								
0	5.48	38.9	6.6	33.9	0.47	7.5	1.47	17.9
40	5.98	42.4	7.2	37.1	0.48	7.4	1.46	17.9
80	6.30	44.7	7.5	39.1	0.49	7.4	1.46	18.0
120	6.38	45.3	7.6	39.5	0.49	7.4	1.45	18.0
CD (P = 0.05)	0.14	1.0	NS	1.4				
Initial value					0.43	7.8	1.49	17.5

Data pooled over two years

of experiment in March 2007, was found to increase markedly over initial value under all the treatments except sole baby corn. In spite of less addition of litter of Jatropha in Jatropha + baby corn stand compared to sole stand of Jatropha, SOC was marginally higher in intercropped stand. Significant increase in SOC content in sole Jatropha and Jatropha + baby corn over the initial value, induced marked changes in SOC related soil properties such as soil pH, bulk density and water holding capacity (Table 4). Water holding capacity of the soil recorded improvement under all the systems of planting except sole baby corn compared to initial values (Table 4). While, carbon content in the litter varies from 40 to 50%. On the basis of lower limit of carbon content, average addition of 6 Mg litter fall/ha/year contributed 2.4 Mg carbon/ha/year, which worked out to be 240 g carbon/m/year through litter fall of Jatropha. Results of the experiment are in line with findings reported on the contribution of litter/carbon under trees plantation and their association with field crops (Swamy and Puri 2005, Manna and Singh 2001, Oelbermann *et al.* 2006). The amount of C sequestered depends on the type of agroforestry system, environmental factors and management practices. Carbon input through litter fall of Jatropha in this study fall within the range of carbon input reported by (Oelbermann *et al.* 2006) for *Erythrina poeppigiana* Walp plantation and its association with different crops. Build up of soil organic carbon from 2.4 to 6.4 g/kg after 10 years of establishment of orchard cropping system was reported by (Manna and Singh 2001). This increase in soil organic carbon was attributed to recycling of bio-litters. The organic carbon bio-litter turnover was found to increase with the age of plantation. Average carbon inputs of bio-litter to the soil in monocrop (0.98 Mg/ha/year) were less than intercropped systems (2.07 Mg/ha/year). Total carbon content was found to increase by 13 to 34% after five years planting of *Gmelina arbore* (Swamy and Puri 2005). They further reported that net carbon sequestration in the soil ranged from 2.16 to 10.8 Mg/ha over the five years.

CONCLUSION

Based on the results obtained, we conclude that in 3.0 × 2.0 planting geometry of Jatropha, sufficient photosynthetic active radiation are available for successful intercropping of maize and other suitable crops during spring/summer season. Jatropha intercropped with baby corn induced marked increase in productivity and economics of production compared to sole Jatropha. In intercropped stand, 80 kg N/ha given to baby corn was found sufficient to meet the requirement of both the components of the system, while in sole Jatropha 40 kg N/ha was found optimum. Jatropha has potential to make high input of organic materials and recycled nutrients through foliage, flowers, fruits and twigs, due to its very fast growth and profuse foliage production during rainy season and shedding of all before the onset of summer season. Bio-litter addition induced marked improvement in soil organic carbon content and SOC related soil properties.

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