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Productivity and profitability of coconut based cropping systems with fruits and black pepper in West Bengal

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ABSTRACT

Six coconut based cropping models *i.e* Model I:Coconut + Black pepper + guava, Model II: Coconut + Black pepper + lime, Model III :Coconut + Black pepper + lemon, Model IV :Coconut + Black pepper + Pineapple, Model V: Coconut + Black pepper +Banana and Model VI : Coconut + Black pepper were evaluated at HRS, Mondouri, BCKV, West Bengal during the year 2003 to 2008 in a 26 years old coconut plantation. Economic assessment of models revealed that out of 6 models, Model-V (consists of coconut, black pepper, pineapple) was more remunerative showing highest net return of ₹ 45600/- per/ha followed by Model-IV (₹ 36050/-) per/ha It was also observed that multiple cropping in coconut plantation under recommended package of practice of both main crop and intercrop, had no adverse effect on production of coconut. Fruit based cropping system with coconut, comprising of coconut, black pepper, pineapple was found best under West Bengal condition.

Key words: Coconut, intercrop, fruit and effect

Multispecies and multistoried cropping system ensure maximum resource capture and use, leading to higher yield per unit area of soil, water and light. Improvement in the soil properties and biological activities in the root region due to intercropping, results in the modification of soil environment for the benefit of the plant growth(Maheswarappa *et al.*, 1998). Effective utilization of available space, both horizontally and vertically, is the modern concept of cropping system. Growing coconut as monocrop is not the most efficient way of using natural resources. Adoption of coconut based multiple cropping system emerges as the viable way for improving the economic status of coconut farmers. Studies revealed that natural resources *i.e.,* soil, water, air space and solar radiation are not fully utilized under the spacing schedule 7.5 m x 7.5 m . Further, in India, coconut is primarily a crop of small and marginal farmers (Rethinam,1990). A well designed high density multistoreyed crop model suited to a given agro-climatic situation generates greater biomass output, yields more economic produce, generates steady and higher total income, additional employment opportunities for family labours and meets diversified needs of the farmers, such as food, fruit, vegetables, fuel, etc.(Rethinam,1990; Ghosh and Hore, 2007; Hore *et al.* 2007; Ghosh *et al.*,2008).

Fruits are good source of fiber, vitamins, minerals, and antioxidant. Dietary fiber is very important for our digestive system. Antioxidant will help us to prevent cancer. Eating more fruits could significantly reduce the risk of many chronic diseases, high B.P, obesity, heart disease and some cancers. Bananas have a natural antacid effect in the body. Because bananas are easy to digest and are very nutritious they are the first fruit offered to babies. Bananas are good to avoid colorectal cancer and in women, breast cancer and renal cell carcinoma. The pineapple is a fruit native to the Asian tropics, with a delicate and fresh fragrance that's simply irresistible! Lemons contain anti-oxidant and anti-cancer properties. Citric acid is another important ingredient in lemon after vitamin C. Lemon contains more potassium than apple or grapes, which is beneficial to the heart (internet).

Black pepper or 'Kali mirch' is the most important spice of the world and so also is of India. It , therefore, is rightly called the 'King of Spices', as the volume of international trade of it is the highest among all the spices known. Black pepper performed well under coconut (Ghosh, 2009). The present investigation was undertaken to find out the suitable fruit based model for coconut based multiple cropping system for maximisation of return per unit area.

MATERIALS AND METHODS

The experiment was carried out in 26 years old coconut (cv. East Coast Tall) plantation of AICRP on Palms at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia during 2003 to 2008. The research station is situated at 23.5^0 N latitude and 89^0 E longitude with an altitude of 9.75 m above the mean sea level. The soil of the experimental plot was Gangetic alluvial, sandy loam in texture, well drained with medium fertility status. The coconut palms were spaced at 7.5 x 7.5 m. (recomended by CPCRI for tall variety). The study was based on 6 coconut based cropping models *i.e.*, the experiment was laid out with six crop models including one control. The model I consists of

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coconut , black pepper, guava; Model II consists of coconut, black pepper, lime;Model III consists of coconut, black pepper, lemon; Model IV consists of coconut, black pepper, banana; Model V consists of coconut, black pepper, pineapple; Model VI coconut, black pepper was considered as control. Percentage of land area occupied by coconut = 22%, an intercrop = 68%, ridge, channel etc. = 10%.In each model 4 rows of coconut were allotted consisting of 6 palms in each row (24 palms in each model) covering an area of 1350 m^2. The experimental plots were prepared thoroughly by repeated ploughing to get a fine tilth. Well rotten FYM (10 t ha^{-1})was applied and mixed thoroughly during land preparation.

Irrigation was given after planting or sowing of intercrops. Need based irrigation was given for intercrops and main crop. Plant protection measures were taken as and when necessary for all crops. Schedule management practices (AICRP on Palms recomendation) were followed in coconut under both intercropped and monocropped block. Nutrient management and cultural aspect of different crops are given in table 1.The benefit (or net return) : cost ratio of different cropping models were calculated on the basis of cost of cultivation, gross return and net return. The economic assessment was carried out considering the cost of inputs and market price of the produce during the period of experimentation.

RESULTS AND DISCUSSION

Intercrop yield, nut equivalent yield ha^{-1} and coconut yield under CBCS

The model wise nut . yield $ha^{-1}yr^{-1}$and intercrop yield kg ha^{-1}were presented in the table-1. Maximum mean nut yield (13612 nuts ha^{-1}) was recorded under model II as compared to control(11088 nuts ha^{-1}). Yield of different intercrops were: guava 1300 kg ha^{-1}, lime 800 kg ha^{-1}, lemon700 kg ha^{-1}, Banana 4000 kg ha^{-1}, pineapple 9700 kg ha^{-1}, black pepper yield varied 42 to 48 kg. Nut equivalent yield ha^{-1} for an intercrop was maximum in case of pineapple (13988) and nut equivalent yield for CBCS model/annum was maximum (26718) under model V (Table 3).

Impact of cropping system on plant nutrient status in soil

Nutrient status of the soil from different plots under different cropping models is given in table 5. Total nitrogen and available phosphorus content (0.117%) was maximum under Model-V. Available phosphorus content (78 ppm) was maximum under Model-II. The maximum available potassium contents were 154.7 ppm under cropping Model-III. The minimum values for the nitrogen, phosphorus and potassium were observed in monocropping plots (Model-VI). The NPK contents under different cropping systems increased over the initial status indicating that addition and recycling of organic matter added considerable amount of nutrients into the system which was also recorded earlier (Maheswarappa *et al.*,1998).The nitrogen, phosphorus and potassium contents of each plot decreased with the soil depth in all models which may be due to lower leaching losses or fixation than higher uptake of N, P and K by crops (Sharma and Chowdhury,2002). Bopaiah and Shetty (1991) also reported the higher phosphatase enzyme activity in the coconut mixed farming plots favoured the release of fixed phosphorus. The nitrogen fixers and phosphate solubilizing bacteria were more in mixed farming system as compared to coconut monocropping. The soil enzyme activities (urease and dehydrogenase) and soil microbial biomass were higher in coconut based mixed farming as compared to coconut monocropping.

Comparative economics of different coconut based cropping models

The six cropping models along with the coconut monocropping were being compared to identify the best one. Cost of cultivation and net returns from one hectare of monocropped coconut were ₹ 21700/- and ₹17948/- with B : C ratio of 0.83.The maximum cost of cultivation was incurred in Model-V (Rs. 39200/-) followed by Model-IV (₹30100/-), Model-II (₹26280/-) and Model-I (₹25750/-). Economic assessment of models revealed that out of 6 models, Model-V (consists of coconut, black pepper, pineapple) was more remunerative showing highest net return of ₹ 45600/- followed by Model-IV (₹36050/-).Maximum B : C ratio was recorded in Model-IV(1.20) followed by Model-V (1.16). The present findings very well coroborate to the findings of Sairam *et al.* (1997) who obtained a net profit of ₹ 24,000/- ₹20,500/- and ₹11,000/- from ginger, turmeric and elephant-foot yam grown as intercrop. Sharma and Chowdhury (2002) obtained gross return of ₹1,25,285/- and ₹ 73,545/- from one hectare coconut based cropping system with cost : benefit ratio of 1 : 1.4. In an other system studied by Girijadevi and Nair (2003) the net return of ₹ 2,74,808/- was realised from coconut + banana + elephant-foot yam and ₹ 1,13,644/- from coconut + banana + turmeric per year in one hectare plantation.

It is well accepted that inter cropping system under coconut is more profitable than mono cropping which promises to the farmers a lot besides generating additional employment opportunity (Nath, 2002). These results clearly indicated the economic viability of companion cropping system with coconut under alluvial plains of West Bengal. Coconut based cropping system (Model V) preferring fruit crop, comprising of coconut, black pepper, pineapple found best under West Bengal condition.

Table 1: Cultural aspects and nutrient management of intercrops under different cropping models (Recommended)

Crop	Variety	Planting time	Plants ha^{-1}	Spacing (cm)	FYM (kg plant^{-1})	NPK (g plant^{-1})
Coconut	ECT	26 yrs old	175	750x750	25	500 : 320 : 1200
Guava	L-49	July('03)	144	750x750	10	260 : 320 : 260
Lime	Local	July('03)	144	750x750	10	200 : 200 : 250
Lemon	Local	July('03)	144	750x750	10	200 : 200 : 250
Pineapple	Kew	June('03)	9200	90x60		
Banana	Martaman	June ('03)	1000	200x200	10	200:85:240

Fertilizers were applied in two splits i e., pre-monsoon and post-monsoon,

Table 2: Intercrop and coconut yield under CBCS (mean of two years)

Model	Intercrop (fruits)	Yield (kg ha^{-1})	Black pepper yield (kg ha^{-1})	Coconut yield (nut ha^{-1})
Model I	Guava	1300	40	13177
Model II	Lime	800	46	13575
Model III	Lemon	700	48	13612
Model IV	Banana	4000	42	11750
Model V	Pineapple	9750	42	12737
Model VI	-	-	44	11088

Table 3: Nut equivalent yield ha^{-1} for an intercrop and for CBCS model annum^{-1} (average of two years)

Intercrop	Nut equivalent yield	Model	Nut equivalent yield
Guava+ Black pepper	2972 +700	Model I	16849
Lime+ Black pepper	2743+805	Model II	17123
Lemon+ Black pepper	2400+840	Model III	16852
Banana+ Black pepper	9143+735	Model IV	21628
Pineapple+ Black pepper	13988+735	Model V	27443
Black pepper	770	Model VI	11858

Table 4: Economic evaluation of different cropping models(average of two years)

Model	Cost of cultivation (₹ha^{-1})	Gross return (₹ha^{-1})	Net return (₹ha^{-1})	NR : Cost
Model I	25750	53837	28087	1.09
Model II	26280	51362	25082	0.95
Model III	25840	54162	28302	1.09
Model IV	30100	66150	36050	1.20
Model V	39200	84800	45600	1.16
Model VI	21700	39648	17948	0.83

This will not change yield of all component crops taken into consideration

Table 5: Soil nutrient status under different cropping systems

Models	Pre-experiment			Post-experiment		
	Nitrogen (%)	Phosphorus (ppm)	Potassium (ppm)	Nitrogen (%)	Phosphorus (ppm)	Potassium (ppm)
Model I	0.087	54.3	122.4	0.114	66.5	139.5
Model II	0.083	62.4	114.2	0.115	78.0	143.4
Model III	0.084	56.3	119.5	0.108	69.4	154.7
Model IV	0.088	58.2	113.7	0.112	61.3	118.2
Model V	0.940	56.9	113.8	0.117	63.4	151.2
Model VI	0.087	58.1	115.6	0.093	60.3	119.4

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