Original Research Article

Assessment of vegetable crops as intercropping system in Arecanut garden for additional returns

ABSTRACT

A field experiment was conducted onassessment of vegetable crops as intercropping system in arecanut garden for additional returnsat different villages of Tiptur taluk, Tumkur districts of Karnataka during from 2015-16 to 2016-17 to studies the influence of intercropping system on chali arecanut yield, economics of arecanut based intercropping system with vegetable crops and the soil fertility status of arecanut garden. The experiment consisted of three different intercropping systems *viz.,*Arecanut sole cropping asfarmers practice (T_1), Arecanut + vegetable cowpea(T_2) and Arecanut + French bean(T_3) with seven replication at farmers field. 26 year old arecanut garden of Gubbi local variety planted at 2,7 m x 2.7 m spacing. The average two year results of experiments were recorded.The yield of arecanut was found to higher chali yield (12.53 q/ha/year)under french bean as intercrop in arecanut garden followed by cowpea as intercrop in arecanut garden(12.25 q/ha/year). Whereas lowest yield was recorded in arecanut sole crop in farmers practice. The highest net annual income Rs. 2,56,832/ha and B:C ratio 2.85 were recorded in arecanut + French bean intercropping system with more additional income and market demand of beans followed by arecanut + vegetable cowpea (Rs. 2,29,083/ha and B:C ratio 2.72) with less market demand of vegetable cowpea, where as lowest net annual income Rs.1,45,290/haand B:C ratio 2.29 were recorded in arecanut sole cropping with no additional income from the farmers practices.

The soil fertility status *viz*., NPK availabilityin soil was analyzed before and after the experiment. Gradually increased N, P and K content of soil in arecanut intercropping with beans and cowpea on far with each other, but lowest soil fertility were recorded in arecanut as sole cropping system in farmers practices due to high biomass of french bean and cowpea, which fixes atmospheric nitrogen, residue incorporated into soil and suppression of weed growth results in improvement of soil fertility status. Higher net returns and improve the soil fertility by growing the french bean as intercrops in arecanut garden is more suitable cropping system to boost economy of farmers.

Keywords: Assessment, arecanut, intercrops, income, vegetable andyield.

1. INTRODUCTION

Arecanut or betel nut (*Areca catechu*L.) is one of the important commercial crops grown in India, present ranks first in the world both in area and production of arecanut. Arecanut is mainly used for chewing and extraction of alkaloid purpose as it has got medicinal properties such as astringent, narcotic, antihelmentic and vermifuge. Major Arecanut producing countries of the world are India, China, Myanmar, Indonesia, Thailand, Bangladesh. India ranks first in both area (58.00 per cent) and production (53.00 per cent) of arecanut in the world. Total area under arecanut is around 4.97 lakh ha withthe total production is around 8.33 lakh tonnes. Kerala and Karnataka account for about 70 per cent of country's production during 2017-18 [2]. The unstable arecanutmarket prices in the national and international markets, small and marginal land holdings, lack of value addition facilities *etc*. have aggravated the economic difficulties to many arecanut farmers. However, research efforts have resulted in evolving viable technologies to increase the profitability for arecanut growers by adopting arecanut based cropping systems. Adoption of arecanut based intercropping system is one of the ways to utilize the natural

resources effectively. The potential for increasing the productivity per unit area of land, time and inputs through arecanut cropping system is considerably higher in perennial crops [6, 7].

The main aim of the Krishi Vigyan Kendra is to reduce the time lag between generation of technology at the research institution and its transfer to the farmers for increasing productivity and income from the agriculture and allied sectors on sustained basis. KVKs are grass root level organizations meant for application of technology through assessment, refinement and demonstration of proven technologies under different 'micro farming' situations in a district [9].

Main objective

1) To studies the influence of intercropping system on arecanut yields.
2) To studies economics of arecanut based intercropping system with vegetable crops as compared to farmers practice.
3) To studies the soil fertility status of arecanut garden growing with vegetable crops as intercrop before and after conduct of on farm trials.

2. MATERIALS AND METHODS

The on farm trials were conducted forassessment of vegetable crops as intercropping system in arecanut garden for additional returns at farmer's field of Tumkur district, Karnataka state during the year from 2015-16 to 2016-17.The experiment was laid out three treatmentswith seven trialsin a 26 year old arecanut garden of Gubbi local variety planted with a spacing of 2.7 m x 2.7 m.A plot of arecanut sole crops was maintained as control (Farmers practice), French bean (Arka suvidha variety) and vegetable cowpea (Arka suman variety) as intercrops in arecanut garden.Hullihalli, Margondanahalli and Karikerevillage of Tiptur taluk, Tumkur district wereselected for conduct of two year on farm trials with an area of 1.2 ha every year.

T_1 - Arecanut sole cropping (Farmers practice)
T_2 – Arecanut + vegetable cowpea (Arka suman)
T_3 - Arecanut + French bean (Arka suvidha)

The critical inputs were supplied to farmers and applied as per treatments (T_2) followed University of Agricultural Sciences, GKVK. Bengaluru package of practices and treatments (T_3) followed theIndian Institute of Horticultural Research, Bengaluru (CHES, Hirehalli) as source of technology. The on farm trial plots at farmer's fields were regularly monitored by scientists of Krishi Vigyan Kendra, Konehalli, Tiptur.Basic data of the farmers field was collected before initiation of on farm trials. The data were analysed with appropriate statistical procedures.

3. RESULTS AND DISCUSSION

3.1 Influence of intercropping system on arecanut yield

The yield data (Table 1.) of arecanut were recorded during the year from 2015-16 to 2016-17. The yield of chali arecanut was found toslightly increase during first year and gradually increased to higher yield (12.96 q/ha/year) during second year in french beanas intercrop in arecanut garden followed by cowpea as intercrop in arecanut garden with11.80 q/ha/year during first year and gradually increased to higher (12.70 q/ha/year) during second year. Whereas lowest chali yield was recorded inarecanut sole crop (Farmers practice) during two year as compared to intercropping system in arecanut garden [1, 22].The additional increase in yield of arecanut with intercropping of vegetable crops could be due to synergistic effect of crop combination and also legumes crops increases soil nutrient content. Results analogous to these finding were also reported [14, 16].

Table 1: Influence of intercropping system on arecanut yield

Tech. option	Details of technology	Arecanut chali yield (Q/ha/year)		Cumulative 2 year mean arecanut chali yield (Q/ha/year)
		2015-16	2016-17	
T_1	Arecanut sole crop (Farmers practice)	10.08	10.06	10.07
T_2	Arecanut + Veg. cowpea	11.80	12.70	12.25
T_3	Arecanut + French bean	12.10	12.96	12.53

3.2 Influenced of intercrop yield by cropping system

The yield data on intercrops were recorded (Table 2.) The variation in the yield of the intercrop was found during the cropping period. The data revealed that the intercrop yield of cowpea (29.70 q/ha) and french bean (38.45 q/ha) during first year, which increased to 36.10 q/ha and 45.15 q/ha during second year in cowpea and french bean respectively.Similar results were recorded in growth and yield parameters of vegetable crops as intercrops in arecanut garden (Table 3.). This might be due that the growing of legumes crops such as cowpea and french bean as intercrops in arecanut garden, residual incorporated into soils which improve the physical, chemical and biological property of soil[5, 20].Whereas no additional crops yield was obtained in farmers practices and also decreases soil fertility status[8, 12].

Table 2: Influenced of intercrop yield by cropping system

Tech. option	Details of technology	Vegetable yield (q /ha)		Cumulative 2 year mean vegetable yield (q/ha)
		2015-16	2016-17	
T_1	Arecanut sole crop (Farmers practice)	Mono-cropping	Mono-cropping	
T_2	Arecanut + Veg. cowpea	29.70	36.10	32.90
T_3	Arecanut + French bean	38.45	45.15	41.80

Table 3: Growth and yield parameters of vegetable crops as influenced by cropping system

Tech. option	Details of technology	Growth and yield parameters of vegetable crops						
		Germination percent (%)	Plant height (cm)	No. branches	No. of harvest	No. of pods/plant	Length of pod (cm)	Yield (q/ha)
T_1	Arecanut sole crop (Farmers practice)	--	--	--	--	--	--	--
T_2	Arecanut + Veg. cowpea	75	72	24	4	65	17	32.90
T_3	Arecanut + French	78	64	21	3	56	14	41.80

bean

3.3 Economics of intercropping system in arecanut

The economic of intercropping system in arecanut was worked out by calculating total cost of cultivation, gross return, net return and B:C Ratio (BCR) of all treatment. Total cost of cultivation was calculated by total sum of expenditure of land preparation, seed, manure and fertilizers, plant protection measures, irrigation and labour component and *etc.* in arecanut and intercrops. The data (Table 4) revealed that highest net returns (Rs. 2,56,832/ha/year) and BCR (2.85) was obtained in French beans as intercrops in arecanutfollowed by cowpea as intercrops in arecanut with net return (Rs.2,29,083/ha/year) and BCR (2.72).Whereas lowest net returns (Rs. 1,45,290/ha/year) and BCR (2.29) was obtained in arecanut as sole crop in farmers practice. This might be due to that additional income obtained from growing cowpea and French bean as intercrops in arecanut garden and also market rate of beans as more demand compared to cowpea as less demand in market [4, 18]. The farmers soldthe market price of chali arecanut at Rs. 25570/q, price of beans Rs. 18/kg, Veg. cowpea Rs. 15/kg at farmer field and on that base profitability was calculated [3, 15].

Table 4: Yield and economics of arecanut based cropping system with vegetable crops

Tech. option	Details of technology	Yield of arecanut (q/ha/yr)	Yield of vegetable (q/ha)	Gross income (Rs./ha)	Cost of production (Rs./ha)	Net income (Rs./ha/yr)	B:C ratio
T_1	Arecanut sole crop (Farmers practice)	10.07	--	2,57,490	1,12,200	1,45,290	2.29
T_2	Arecanut + Veg. cowpea	12.25	32.90	3,62,583	1,33,500	2,29,083	2.72
T_3	Arecanut + French bean	12.53	41.80	3,95,632	1,38,800	2,56,832	2.85

(Market rate of chali arecanut atRs. 25570/q, Price of beans Rs. 18/kg, Veg. cowpea Rs. 15/kg)

3.4 Effect of intercrops on soil fertility status of arecanut

The soil fertility status *viz*., NPK availability, pH and electrical conductivity (EC) in soil were analyzed before initiation and after the experiment and compared with the pre experimental (Farmers practice) soil fertility status. The numerical improved in all the threemajor nutrients were observed over the pre-treatment observation. The available N (282 kg/ha), P (22 kg/ha), K (198 kg/ha) status was higher inarecanut + French bean intercrops, which is on far with arecanut + cowpea intercrops. Whereas lowest available N (262 kg/ha), P (17 kg/ha), K (189 kg/ha) status was recorded in arecanut as sole crops [19]. This might be due to that incorporation of residual after harvest of beans and cowpea pod[14]and also high biomass of French bean and cowpea, which fixes atmospheric nitrogen, residue incorporated into soil and suppression of weed growth results in improvement of soil fertility status [17].

Table 5: Soil fertility status of arecanut intercrops with vegetable crops

Soil fertility status	**Arecanut sole crop**(FP)		**Arecanut + Veg. cowpea**		**Arecanut + French bean**	
	Pre-treatment (2015-16)	Post treatment (2016-17)	Pre-treatment (2015-16)	Post treatment (2016-17)	Pre-treatment (2015-16)	Post treatment (2016-17)
N (Kg/ha)	268	262	268	278	268	282
P (Kg/ha)	19	17	19	21	19	22
K (Kg/ha)	192	189	192	195	192	198

pH	7.1	7.2	7.1	7.0	7.1	7.1
EC(ds/m)	0.30	0.31	0.30	0.29	0.30	0.28

4. CONCLUSION

The experiment concluded that the highest chali arecanut yield, annual net return and B:C ratio were recorded in french bean as intercrops in arecanut garden with more additional income and market demand of beans followed by cowpea as intercrops in arecanut garden, less market demand of vegetable cowpea, where as lowest net annual income were recorded in arecanut sole cropping with no additional income from the farmers practices. The soil fertility status of N, P and K content of soil in arecanut intercropping with beans and cowpea on far with each other, but lowest soil fertility were recorded in arecanut as sole cropping system in farmers practices. Higher net returns and improve the soil fertility by growing the french bean as intercrops in arecanut garden is more suitable cropping system to boost economy of farmers.

REFERENCE

1. Ahmed F, Rahim MA, AlamMS, Hamid MAand HaqueKM. Performance ofmedicinal plants and species in arecanut based agroforestry system. Journal ofAgroforestry and Environment.2007;1: 51-53.

2. Anonymous.Horticultural statistics at glance 2018, Department of Agriculture, Cooperation & Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare, Government of India.2018;pp: 207.

3. Bari MS and Rahim MA.Economic evaluation and yield performance of some medicinal plants in Arecanut based multistoried agro-forestry systems.Scientific journal of Krishi Foundation.2012;10(1): 71-80.

4. Bari MS and Rahim MA. Bio-economic evaluation of Aloe vera in arecanut based multistoried agro-forestry systems. Journal ofAgroforestry and Environment. 2010; 3(2): 61-63.

5. Bavappa KVA. An up to date research profile on arecanut based farming system. In: COCOTECH meeting on arecanut based farming system, 27th June, Manila, Philippines. 1990; 360-389.

6. Bavappa KVA, Kailasam C, Khader KB and Biddappa A. Arecanut and arecanut based highdensity multispecies cropping system. Journal of Plantation crops.1986; 14(2): 74-87.

7. Bavappa KVA and Jacob VJ. High density multispecies cropping – A new approach to small scale farming in the tropics. World crops.1982; 2: 47-50.

8. Dan C, Brainard R, Bellinder R and Antonio DT. Effect of canopy shade on the morphology, phenology and seed characteristics of Powell amaranth. Weed Science. 2005; 53: 175-186.

9. Das P. Proceedings of the meeting of DDG (AE) ICAR with officials of state Departments, ICAR institutes and Agricultural Universities, NRC Mithun, Jharmapani, Zonal Coordinating Unit, Zone-III. Barapani, Meghalaya, India. 2007;pp: 6.

10. Durieux A. Effect of lighting on the production of vegetables crops. IIIInternational symposium on artificial lighting in horticulture. ISHS Acta Horticulturae 418,Netherlands 1997.

11. Islam KK, Pervin MJ, Rashid MH, Mondol MAand Rahim MA. Performance of winter vegetables grown under arecanut lemon based multistoried agroforestry system.Tropical and Subtropical Agro-ecosystems, 2008; 8: 165-170.

12. Khandekar RG, Nagwekar DD, Sawant VS, Gurav SS and Haldankar PM. Performance of Morinda citrofolia as mixed crop in Arecanut under Konkan Region of Maharashtra. International journal of Research in Emerging Science and Technology.2014; 1(4):6-66.

13. Maheswarappa HP, Anitakumari P and Sairam CV. High density multispecies cropping system for root (wilt) affected arecanut gardens – Its impact on productivity and economic viability.Journal of Plantation crops.2003; 31(1): 23-27.

14. Maheswarappa HP, Dhanapal R, Subramanian P and Palaniswami C. Evaluation of arecanut based high density multispecies cropping system under organic and integrated nutrient management. Journal of Plantation Crops.2013; 41(2): 130-135.

15. Maheswari SK, Dhantonde BN, Yadav S and Gangrade SK. Intercropping of Rauvolfia serpentina for higher monetary returns. Indian Journal ofAgriculturalSciences.1985; 58:108-111.

16. Marimuthu R. Multispecies cropping system in arecanut garden, Madras Agricultural Journal. 2005; 92(7&9): 404-406.

17. Mini V, Usha Mathew and Indira M. Nutrient usesStrategies for Arecanut based cropping system in onattukara sandy tract, Kerala. Journal ofAgricultural and VeterinarySciences. 2015; 8(3): 11-15.

18. Nair MK and Gopalakrishnan P. Arecanut based farm family models in India In: COCOTECH meeting on arecanut based farming systems, 27th Manila, Philippine. Proceedings of the meeting.1990; Pp. 360-389.

19. Shajikumar VM. Nutrient cycling in arecanut based agroforestry system- contribution from litter fall of multipurpose trees. Project Report of B.Sc.(Forestry), Kerala Agricultural University, Thrissur. 1991.

20. Sujatha S, Bhat R, Kannan C and Balasimha D. Impact of intercropping of medicinal and aromatic plants with organic farming approach on resource use efficiency in arecanut (Areca catechu L.) plantation in India. Industrial Crops and Products.2011; 33(1):78–83.

21. Thiruvarassan S, Maheswarappa HP and Subramani T. Evaluation of Arecanut based multispecies cropping systems for East Coast Region of Tamil NaduJournal ofAndaman Science Association.2014; 19(1): 59-64.

22. Varghese PT, Nair PKR, Nelliat EV, Rama Varma and Gopalsundaram P. Intercropping with tuber crops in arecanut garden, 399-415. In: Proceedings of 1st Plantation Crops Symposium (PLACROSYM I). Placrosym standing committee, Kasaragod, India. 2013.

Fig 1.Assessment of vegetable crops in arecanut garden