

Original Research Article

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Intercropping in Young Oil Palm Plantation under Konkan Region of Maharashtra, India

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ABSTRACT

Oil Palm is vertically growing perennial crop attains a height of about 20 to 30 meter with economic life of 35 years. It is planted on wider space and under good management it takes three years to utilize entire inter space. Since it is vertically growing perennial crop, there is ample scope for raising intercrops in oil palm plantations during the initial 3-4 years. Hence, attempt was made to suggest suitable intercrops in juvenile oil palm garden. A field experiment was conducted under young oil palm plantation of AICRP on Palms (Oil palm) project at College of Horticulture, Mulde during the year 2014 to 2017 to find out compatible and profitable intercrops at juvenile stage of the crop. Common crops viz., Banana, Pineapple and Elephant foot yam were taken as intercrops. Three years study revealed that, growing banana as an intercrop in oil palm, farmers can get Rs. 55,833 ha⁻¹ from Elephant foot yam Rs. 61,950 and Rs. 27,500 from pineapple. The study also revealed that the net returns were Rs. 89,549 year⁻¹ in mix cropping with B: C ratio of 1.83 while it was negative (Rs. 10,021/- year⁻¹) when oil palm was taken as sole crop. Yield of oil palm in intercrops was 10.53t ha⁻¹ while it was only 7.64 t ha⁻¹ in without intercrops. Thus, study brought out an alternative to make young Oil Palm orchard profitable by growing Banana, Pineapple and Elephant foot yam as an intercrop up to 4 years under South Konkan region of Maharashtra.

Keywords

Banana, Pineapple,
Elephant foot yam,
Intercrop

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Introduction

Oil Palm is an unbranched monoecious, monocotyledonous tree attains a height of about 20 to 30 meter having economic life of 35 years. It is recognised as the major source

of vegetable oil with an average oil yield level of 4 to 6 tonnes per hectare compared to any other oil yielding crop including coconut and groundnut (Vasanthkumar, 2005). It is planted at a wider space of 9 m x 9 m x 9 m in a triangular system. It occupies only 5-15 %

area during the juvenile phase of the garden (Suresh and Rethinam, 2001). Similarly, 60 to 65 % of the area remains vacant in mature oil palm gardens. Active root system of adult palms under good management is mainly concentrated within a radius of 0.5 to 3m laterally from the bole and 10-40 cm depth vertically (Suresh *et al.*, 2003). This situation offers an ample scope for effective utilization of horizontal and vertical space for growing intercrops, thus providing additional employment opportunities and income for small and marginal farm families during the initial three years of oil palm cultivation (Reddy and Prasad, 2011). The main objectives of intercropping are effective utilization of space left between two rows of the main crop and out per unit area. Studies conducted by Reddy *et al.*, (2004) on intercropping in oil palm during juvenile phase revealed that there was no adverse effect on growth of oil palm and also intercrops added lot of biomass (varied from 0.5 -17 tha^{-1}) which can be utilized by oil palm in future.

Under good management oil palm takes three to four years to utilize entire inter space. Intercropping in the interspaced of oil palm is practiced only in India. In other countries where oil palm is grown, intercropping is not practiced because land is not constrained as it is in India. Since it is a perennial crop, there is ample scope for raising intercrops in oil palm plantations during the initial 3-4 years. Farmers have to grow intercrops during the juvenile phase as there will not be income from oil palm crop. Similarly, economic condition and size of land holding of Indian farmer, increased cost of production and FFB price fluctuation are forcing them to go for intercropping in grown up oil palm garden also. Study conducted by Reddi *et al.*, (2015) on intercropping in oil palm proved that growing okra as an intercrop with oil palm generated higher net return compared to other

vegetable crops in young oil palm garden. In Maharashtra area under oil palm is increasing through Govt. Schemes and information on growing intercrops in juvenile garden is lacking. With the above background attempt was made to grow suitable intercrops in juvenile oil palm garden.

Materials and Methods

An investigation was carried out in young oil palm plantation of AICRP on Palms (Oil palm) project at College of Horticulture, Mulde during the year 2014 to 2018. The main objective of the study was to identify suitable and profitable inter crops at juvenile stage of the oil palm orchard. Intercrops were planted by keeping 3 m radius free around each palm to avoid any competition as suggested by Reddy and Suresh, (2009). Banana variety Kokan Safed Velchi, recommended by the Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth for Konkan region was planted in between the rows of oil palm at a spacing of 2 x 2.5 m, pineapple variety Queen was planted at 0.45 x 0.45 m in trench having dimension of 3 x 1m (20 plants/ trench) prepared for soil and water conservation along the slop. The elephant foot yam variety Gajendra was grown in kharif during the year 2015, 2016 and 2017 at 0.75 x 0.75 m in a plot size 4.7 x 2 m (12 plants/ plot) in interspaced of oil palm. All crops were fertigated with the recommended dose. During the period from 2015-16 to 2017-18 three harvest of banana (main crop and ratoon), three harvests of elephant foot yam and only single harvest of pineapple were taken. Yield of mix crops and oil palm were recorded at a time of harvest. Growth and yield observations before and after mix cropping were taken for comparison. Randomly ten leaflets five each from both side of leaf from with and without intercrops were taken from sixteen, seventeen and eighteen number leaf for recording leaf parameters. Average leaf length (cm), width (cm) and leaf

area (cm²) were calculated with the help of Portable leaf area meter (Licor, company, USA. Model. LI-COR, LI 3000C). Oil Palm equivalent yield was calculated as per formula given below:

Oil Palm equivalent yield

$$= \frac{\text{Yield of intercrop} \times \text{price of intercrop}}{\text{Price of Oil Palm}}$$

The cost of cultivation, economics and benefit cost ratio were worked out based on the prevailing market prices. Intercrops yield were converted to oil palm equivalent yield in order to the significance. The data were statistically analysed by the method described by Gomez and Gomez (1984).

Results and Discussion

Nutrient status in the soils

Data regarding nutrient status in the soils at initial stage and after completion of experiment (with and without intercrop plots) are presented in Table 1. Data presented in table revealed that except nitrogen all components were increased in the soils where intercrops were taken. Nitrogen content in the soils in intercrops was 153.66 kg h⁻¹ whereas it was 175.61 kg h⁻¹ in without intercrops. Decreased in nitrogen content in intercropped soil indicate needs to increase nitrogenous fertilizer while planning intercrops.

Performance of intercrops in oil palm

The three years data on yield of oil palm as sole and in intercropping system are presented in Table 2. Data in the table revealed that the yield in intercropping system was significantly increased every year than sole crop. It was 5.00, 12.40 and 14.20 t ha⁻¹ during 2016, 2017 and 2018 respectively. Whereas, it was 3.74, 9.51 and 9.92 t ha⁻¹ during respective years in sole crop. The pooled mean indicated that

yield increment in oil palm (FFB) in mix cropping was 36.40 per cent than sole crop. This could be attributed to better growth as indicated by increase in number of leaves and leaf area of the palms under intercropping system. This phenomenon is well supported by Nath *et al.*, (2015) who observed increased in nut yield of coconut in the intercropping situation compared to sole crop.

The yield data of intercrops in mixed cropping system presented in Table 3 revealed that in first year, banana recorded the highest yield (2.9t ha⁻¹) while elephant foot yam recorded significantly highest yield (2.3 t ha⁻¹) during second year. During third year maximum yield was noticed in pineapple (2.5tha⁻¹). Pooled mean data revealed that the maximum yield (2.28 t ha⁻¹) was recorded in banana followed by elephant foot yam (1.82 t ha⁻¹). Decreased in banana yield in subsequent year may be due to ratoon crops. The year 2015 -16 was the first year and pineapple crop was in establishment phase hence yield of pineapple did not obtain during 2015-16. The total yield of oil palm and three intercrop soil palm equivalent yield (OEY) for three years are given in Table 4. Data revealed that total yield in intercrop including OEY of intercrop was 13.09 t ha⁻¹ while in sole crop it was 7.72 t ha⁻¹ which indicated 69.56 per cent yield increment due to mix cropping.

The data on economics of the intercropping system and sole oil palm crop are presented in Table 5 and 6. The cost of production of sole crop for three years was Rs.1,63,000 t ha⁻¹ while it was Rs.3,33,629t ha⁻¹ in intercropping system. The gross returns per hectare for three years was Rs.5, 91,269/- in intercropping and Rs.1, 32,937t ha⁻¹ in sole crop. The net returns per year was the highest (Rs. 89,549/-) in intercropping earning Rs.89,570t ha⁻¹ as an additional returns than sole crop. The highest B:C ratio (1.83) was noted in intercropping system as against 0.82 in sole oil palm crop as it is in juvenile phase.

Table.1 Nutrient status in the oil palm plantation

Sr. No.	Treatments	pH	OC (g kg ⁻¹)	N (kg h ⁻¹)	P (kg h ⁻¹)	K (kg h ⁻¹)
1	Initial Soil sample	4.78	2.06	163.07	2.17	678.70
2	With Intercrop	5.07	2.61	153.66	3.58	927.3
3	Without Intercrops	4.88	2.02	175.61	2.07	827.7

Table.2 Yield of oil palm in intercrop and sole crop

System	Oil Palm yield (t ha ⁻¹)			
	2015-16	2016-17	2017-18	Pooled mean
Yield of oil palm in mixcrop	5.00	12.40	14.20	10.53
Yield of sole oil palm	3.74	9.51	9.92	7.72
SE ±	0.03	0.11	0.11	0.04
CD at 5%	0.1	0.34	0.34	0.12
% increase of yield over sole crop	33.69	30.39	43.29	36.40

Table.3 Yield of Intercrops in intercropping systems

System	Intercrop yield (t ha ⁻¹)			
	2015-16	2016-17	2017-18	Pooled mean
Banana	2.90	2.34	1.59	2.28
Pineapple	0.00	0.80	2.51	1.10
Elephant Foot Yam	0.93	2.63	1.90	1.82
Sole Oil	0.00	0.00	0.00	0.00
SE ±	0.02	0.05	0.02	0.02
CD at 5%	0.06	0.14	0.07	0.06

Table.4 Total Oil Palm Equivalent Yield (OEY) of mixed cropping system

System	Total Oil Palm yield (t ha ⁻¹) (Including intercrop yield)			
	2015-16	2016-17	2017-18	Pooled mean
Oil Palm + Banana+ Pineapple + Elephant Foot Yam	6.81	15.34	16.76	13.09
Sole Oil Palm	3.74	9.514	9.916	7.72
% increase of yield over sole crop	82.08	61.24	69.02	69.56

Table.5 Performance of oil palm and intercrops during 2015-16to 2017-18

Crops	Area covered under intercrops	Plant population (ha ⁻¹)	2015-16		2016-17		2017-18		Mean	
			Yield (t ha ⁻¹)	Gross Rs.	Yield (t ha ⁻¹)	Gross Rs.	Yield (t ha ⁻¹)	Gross Rs.	Yield (t ha ⁻¹)	Gross Rs.
Banana	3600 Sq. m.	1287	2.8	70,000/-	2.3	57,500/-	1.6	40,000/-	2.23	55,833/-
Pineapple	752 Sq.m.	2860	-	-	0.790	15,800/-	2.5	62,500/-	1.10	27,500/-
Elephant Foot Yam	240 Sq.m.	1716	0.895	35,800/-	2.5	87,500/-	1.9	66,500/-	1.77	61,950/-
Oil Palm within intercrop		143	5.0	29,000/-	12.4	71,920/-	14.2	82,360/-	10.53	61,093/-
			Total	1,34,800/-		2,32,720/-		2,51,360/-		
Oil Palm without intercrop		143	3.7	21,460/-	9.43	54,695/-	9.79	56,782/-	7.64	44,312

Table.6 Total cost and total returns due to intercrops and oil palm without intercrops

Particulars	Total Cost Rs.			Gross Total Cost Rs.	Gross Returns Rs.			Total Gross Returns Rs.	Net Returns Rs.	Net Returns/ year Rs.	Additional Returns Due to intercrops/year	B : C ratio
	2015-16	2016-17	2017-18		2015-16	2016-17	2017-18					
Oil Palm with Intercrops	155,078/-	84,853/-	82,698/-	3,22,629/-	1,34,800/-	2,32,720/-	2,51,360/-	5,91,269/-	2,68,648/-	89,549/-	Rs.89,570/-	1.83
Oil Palm without Intercrops	53,000/-	55,000/-	55,000/-	1,63,000/-	21,460/-	54,695/-	56,782/-	1,32,937/-	(-) 30,063/-	(-)10,021/-		0.82
Sale price Oil Palm @ Rs. 5,800/tBanana @ Rs. 25/kg, Elephant foot yam @ Rs. 35/ kg and pineapple @ Rs. 25/ kg												

Table.7 Effect of intercropping on height and number of leaves oil palm

Particulars	Av. Height (m)		Av. Number of leaves		Leaf length (m)	No. of leaflets	Length of Leaflet (cm)	Width of Leaflet (cm)	Maximum width of Leaflet (cm)	Leaflet area (cm ²)	Average Yield (t/ha)
	Before intercrops	After intercrops	Before intercrops	After intercrops							
Oil Palm with intercrops	0.96	2.61	22.01	29.82	4.89	264.8	79.01	3.36	4.47	258.25	10.53
Oil Palm without intercrops		2.18		28.42	4.18	240.9	74.28	3.17	4.31	252.80	7.72
SE ±		0.12		0.02	0.04	0.60	0.01	0.02	0.03	0.01	0.04
CD at 5%		0.33		0.06	0.12	1.80	0.03	0.06	0.09	0.03	0.12

Fig.1 Performance of elephant foot yam under oil



Fig.2 Performance of pineapple under oil palm



Similar findings were observed by Reddi *et al.*, (2015) when okra was taken as intercrop in oil palm. Reddy and Suresh (2009) found banana was the most profitable crop when compared with turmeric and spider lily.

Effect of intercropping on oil palm

Data on effect of intercropping in oil palm on morphological parameters are presented in Table 7. It is revealed that palm average height and average number of leaves at a time of planting intercrop were 0.96 m and 22.01 respectively. After three years of intercropping the palms in intercrop attained height of 2.61 m while it was 2.18 m in without intercrop. This indicated that palm height was increased due to intercropping. This could be due to available moisture and shade. Similarly, after three years of intercropping palms in intercrops produced 29.82 leaves while it was 22.01 in without intercrops which were only 22.01 prior to intercropping. Similarly, palms in intercrops recorded increase in leaf length (4.89 cm), number of leaflets (264.8), length of leaflet (79.01 cm), width of leaflet (3.36 cm), maximum width of leaflet (4.47 cm), leaflet area (258.25 cm²) and yield also (10.53 t ha⁻¹) as compared to 4.18 m, 240.9, 74.28 cm, 3.17cm, 4.31cm, 252.80 cm² and 7.72 t ha⁻¹ respectively in without intercrops. This increased in leaf production and leaf area under intercropping might have resulted in increased in bunch yield of oil palm under intercropping (Nath *et al.*, 2015).

This study revealed that the yield of oil palm in intercropping system was triggered 36.40 per cent over sole crop along with the additional yield of intercrops (banana, pineapple and elephant foot yam) which provided the additional returns and highest the C:B ratio (1:1.82) suggesting the compatibility of oil palm for intercropping.

Thus it can be concluded that growing banana, pineapple and elephant foot yam as an intercrop in young oil palm garden up to 4 years is the best proposition for earning additional returns from juvenile oil palm orchard under South Konkan region.

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