Performence of Oil Palm Production Technologies

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ABSTRACT

Oil Palm plays significant role to meet the vegetable oil requirements in India, because of its highest productivity with more returns to the farmers than any other edible oil yielding crop. In India the net area under oil palm cultivation is 1,01,128 ha and there is a great scope to increase the area yet further. To know the adoption pattern and to enumerate various constraints in adoption of improved production technologies, the present study was conducted among 516 respondents selected randomly from three major states growing oil palm viz., Andhra Pradesh, Karnataka and Goa. Majority of the oil palm growers were marginal (31.59%) and small farmers (27.91%). In India wide introduction of oil palm (62.60%) was taken place during the years 1993 to 1997. Most of the respondents (74.61%) were following basin method of irrigation with four to seven days interval (29.84%) to irrigate the palms. More than eighty per cent of the farmers were applying farmyard manure. Most of the respondents were applying lower doses of Nitrogen (54.07%), Phosphorus (42.64%) and Potassium (34.69%) and majority of the farmers were not applying micronutrient fertilizers. Majority of the farmers (34.69 %) were applying fertilizers in 2 split doses.

Key words: *Oil Palm; Adoption index; Rate of adoption; Fresh fruit bunch yield;*

In India there is a great need to increase the oil seed production, as it is the second largest in area and production, after food grains. As, we know increasing demand coupled with low production of oil seeds in the country has necessitated the import of vegetable oil, so as to meet the demands of ever growing population. Oil palm gained a significant role in achieving this target, because of its highest productivity with more returns to the farmers than any other edible oil-yielding crop. The production of palm oil by major Oil Palm growing countries indicated a steady progress compared to other oil seed crops (*Rethinam, 1998*). In India Oil Palm is being cultivated commercially since 1990. The net area under oil pal m cultivation is 1,01,128 ha, against the potential area of 10,36,500 hectares(*Chadha, 2006*), where in low productivity is the major constraint. In order to identify the adoption pattern in adopting the recommended package of practices, a survey was conducted among the farmers from Andhra Pradesh, Karnataka and Goa who had attended various training programmes at Directorate of Oil Palm Research, Pedavegi, West Godavari District of Andhra Pradesh. The results of the study may throw some light to know adoption pattern and reasons for low productivity etc., Inferences may give physical, financial, technical and policy issues to be addressed by various agencies to increase the oil palm production. The present study was conducted with the following objective.

METHODOLOGY

Among 3,500 farmers attended the training programmes on oil palm cultivation during 2001- 08, 516 farmers were selected randomly and subjected to open ended questionnaire. After having detailed discussion with subject matter specialists, various package of practices were taken as independent variables and yield as dependent variable. Frequencies were calculated based on the variables measured (viz., size of farm holding, age of plantation, method of irrigation, frequency of irrigation, type of organic manures applied, quantity of manure applied, quantity of N, P, K, MgSO4, Boron fertilizers, frequency of fertilizer application, yield and adoption gap) by taking the highest and lowest score in that category. Yields obtained by farmers were categorized based on year of plantation and divided in to four groups. Within the group the yields obtained by

the farmers were categorized in to seven subgroups. Adoption gap was arrived from adoption index (total obtained score of the practices adopted by the individual farmer with that of the total obtainable score expressed in per centage). Practice wise adoption index was arrived based on the total scores obtained by the farmer to the practice. Rate of adoption was arrived by collecting the year of adoption of oil palm by the farmer. The data thus collected were tabulated, analyzed by using necessary statistical tools and interpreted.

RESULTS AND DISCUSSION

Farm Holding: The results indicated that majority of the farmers (31.59%) were having a land holding of 2 ha (Table 1) followed by 27.91 per cent of the farmers were having $\leq$1 ha, 17.25 per cent of them were having >4 ha, 12.79 per cent of them were having 3-4 ha and remaining 10.47 per cent of them were having 2-3 ha. It indicated that most of the oil palm growers were small and marginal farmers.

Year of Planting: It is understood from the Table 1 that, in India oil palm was widely adopted (62.60%) during 1993 to 1997 and it can also be understood that, majority of the farmers in India were in early adopters category. Hence the services of innovators and early adopters can be utilised for farmer-to-farmer linkage and oil palm area expansion.

Method of Irrigation: Majority of the farmers (74.61%) adopted basin method of irrigation followed by drip method (15.89%) to irrigate the oil palm plantations (Table 2a). Majority of the farmers adopted basin method of irrigation, might be due to unawareness of the farmer about the advantages of the micro irrigation system. Though the present study implies that there is reduction of use of flooding method of irrigation from 6.17% during 1988-'92 to 0.91% during 1998-'02 and increase in use of drip and microjet systems (Table 2a), still awareness needs to be created among the oil palm growers for adopting micro irrigation.

The results (Table 2b) showed that majority of the farmers (29.84%) were irrigating at four to seven days interval followed by 24.42 per cent were following seven to ten days intervals. Oil palm is having adventitious root system and penetrating to a depth ranging from 0.6 m to 1.0 m and spread over to a radius of 1.8 to 3 meters. Oil palm requires copious irrigation and the average water requirement of an adult palm is around 300-350 litres per day based on the soil and climatic conditions. Since majority of the farmers were following basin

Table 1. Distribution of respondents according to their size of farm holding

Farm Size (ha)	Year of Planting								Total	
	1988-'92		1993-'97		1998-'02		2002-'07			
	No.	%*	No.	%*	No.	%*	No.	%*	No.	%*
<= 1	17	3.29	90	17.44	36	6.98	1	0.19	144	27.91
1 - 2	22	4.26	104	20.16	36	6.98	1	0.19	163	31.59
2 - 3	8	1.55	38	7.36	8	1.55	0	0.00	54	10.47
3 - 4	15	2.91	40	7.75	11	2.13	0	0.00	66	12.79
> 4	19	3.68	51	9.88	19	3.68	0	0.00	89	17.25
Total	81	15.70	323	62.60	110	21.32	2	0.39	516	100.00

* Percentage calculated based on total frequency

Table 2a. Distribution of respondents according to method of irrigation adopted over years

Irrigation System	Year of Planting								Total	
	1988-'92		1993-'97		1998-'02		2002-'07			
	No.	Col (%)	No.	Col (%)	No.	Col (%)	No.	Col (%)	No.	Col (%)
Basin	61	75.31	240	74.30	83	75.45	1	50.00	385	74.61
Flooding	5	6.17	18	5.57	1	0.91	0	0.00	24	4.65
Drip	12	14.81	50	15.48	19	17.27	1	50.00	82	15.89
Microjet	3	3.70	15	4.64	7	6.36	0	0.00	25	4.84
Total	81	100.00	323	100.00	110	100.00	2	100.00	516	100.00

Table 2b. Distribution of respondents according to frequency of irrigation adopted

Method of Irrigation	Irrigation Interval *										Total	
	<= 4		4 - 7		7 - 10		10 - 13		> 13			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Basin	32	6.20	154	29.84	126	24.42	9	1.74	64	12.40	385	74.61
Flooding	4	0.78	10	1.94	3	0.58	1	0.19	6	1.16	24	4.65
Drip	17	3.29	50	9.69	13	2.52	1	0.19	1	0.19	82	15.89
Microjet	5	0.97	13	2.52	4	0.78	2	0.39	1	0.19	25	4.84
Total	58	11.24	227	43.99	146	28.29	13	2.52	72	13.95	516	100.00

* Unit of irrigation interval for basin and flooding method is in days and unit for drip and microjet method of irrigation is in hours/day.

Table 3a. Distribution of respondents according to type of organic manures applied over years

Manure	Year of Planting								Total	
	1988-'92		1993-'97		1998-'02		2002-'07			
	No.	%	No.	%	No.	%	No.	%	No.	%
Farm Yard Manure	65	80.25	251	77.71	96	87.27	2	100.00	414	80.23
Poultry Manure	1	1.23	12	3.72	2	1.82	0	0.00	15	2.91
Vermi-Compost	1	1.23	4	1.24	0	0.00	0	0.00	5	0.97
No Manure	14	17.28	56	17.34	12	10.91	0	0.00	82	15.89
Total	81	100.00	323	100.00	110	100.00	2	100.00	516	100.00

Table 3b. Distribution of respondents according to quantity of organic manures applied.

Manure	Quantity of Manure Applied (Kg/palm/yr)												Total	
	Not Applied		0 - 25		25 - 50		50 - 75		75 - 100		> 100			
	No.	%*	No.	%*	No.	%*	No.	%*	No.	%*	No.	%*	No.	%
FYM	0	0.00	164	31.78	113	21.90	53	10.27	44	8.53	40	7.75	414	80.23
PM	0	0.00	4	0.78	4	0.78	3	0.58	3	0.58	1	0.19	15	2.91
VC	0	0.00	5	0.97	0	0.00	0	0.00	0	0.00	0	0.00	5	0.97
No Manure	82	15.89	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	82	15.89
Total	82	15.89	173	33.53	117	22.67	56	10.85	47	9.11	41	7.95	516	100.00

* Per centage calculated based on total frequency

Table 4a. Distribution of respondents according to fertilizers (N, P, K) application and Number of Splits

Nitrogen			Phosphorus			Potassium			Fert. appli. in splits		
Category (g/palm/yr)	No.	%	Category (g/palm/yr)	No.	%	Category (g/palm/yr)	No.	%	Split	No.	%
Not Applied	2	0.39	Not Applied	14	2.71	Not Applied	26	5.04	1	35	6.78
0 - 600	174	33.72	0 - 300	113	21.90	0 - 600	142	27.52	2	179	34.69
600 - 900	105	20.35	300 - 450	107	20.74	600 - 900	37	7.17	3	161	31.20
900 - 1200	95	18.41	450 - 600	84	16.28	900 - 1200	118	22.87	4	123	23.84
1200 - 1500	77	14.92	600 - 750	77	14.92	1200 - 1500	3	0.58	5	3	0.58
1500 - 1800	8	1.55	750 - 900	26	5.04	1500 - 1800	54	10.47	6	12	2.33
1800 - 2100	34	6.59	900 - 1050	61	11.82	1800 - 2100	6	1.16	8	1	0.19
2100 - 2400	5	0.97	1050 - 1200	8	1.55	2100 - 2400	62	12.02	10	2	0.39
> 2400	16	3.10	> 1200	26	5.04	> 2400	68	13.18	-	-	-
Total	516	100.00		516	100.00		516	100.00		516	100.00

method of irrigation with an interval of four to ten days, large quantities of water was impounded in the basins. This will result in the loss of huge quantities of water through deep percolation beyond the level of effective root zone, which concentrated mostly on the superficial layers in addition to the leaching of majority of nutrients to the lower layers (*Prasad et. al., 2003*). Hence it is required to create awareness on judicious use of water and increase the frequency of irrigation. Existing government support / assistance is required to be extended to the needy farmers to meet the initial expenditure for establishment of micro irrigation.

Type and quantity of organic manures applied: The results (Table 3a) clearly indicated that 80.23 per cent of the farmers were applying farmyard manure and 15.89% of the farmers were not applying any manure suggesting that the farmers may be unaware of the advantage of applying FYM or any manure. Use of FYM has increased from 80.25 per cent during 1988-'92 to 87.27 per cent during 1998-'02 while percentage of farmers not applying any manure were decreased from 17.28% during 1988-'92 to 10.91 per cent during 1998-'02 implies that it is required to motivate oil palm growers about production of organic manure at farm level and its application in oil palm plantations to have sustainable and higher production. Results also indicated that 53.68 per cent farmers are applying up to 50 kg of FYM (Table 3b). Existing government assistance for establishment of vermi-compost units to the oil palm growers may be provided to large number of farmers. So there by application of required quantity of organic manure to the palms will be increased.

5. Fertilizer management: Oil palm responds well to applied chemical fertilizers like urea, single super phosphate and murate of potash. Oil palm requires 1200:600:1200 g NPK per year for adult palms and 1/3 rd, 2/3 rd of the recommended dose is required to one year and two year old palms, respectively. The results (Table 4a) showed that, most of the farmers were not following the judicious fertilizer management practices. Since the fertilizer management is a crucial in oil palm cultivation, it is required to educate the oil palm growers about its significance in plant growth and yield (*Prasad et. al., 2008*).

Oil palm in the juvenile phase is more susceptible to secondary and micronutrient deficiencies, especially Magnesium and Boron. An adult oil palm requires 500g of Magnesium Sulphate and 1/3 rd, 2/3 rd of the recommended dose of Magnesium during first and second year of plantation. It also requires 50 g of Boron per year in case of any deficiency. The results (Table 4b) showed that only 55.43 and 46.51 per cent were applying the Magnesium and Boron fertilizers, respectively and majority of the farmers were not applying Magnesium and Boron. It is also observed that most of the respondents were applying the recommended dose Magnesium (24.61%) and Boron fertilizers (22.87%).

6. *Frequency of fertilizer application:* The results showed (Table 4a) that 34.69 per cent of the oil palm growers were applying the fertilizers in two split doses followed by 31.20 per cent of the persons were applying fertilizers in three split doses and 23.84 per cent of the persons were applying fertilizers in four split doses. Since there is ample scope for split application of fertilizers under irrigated condition, N and K fertilizer use efficiency can be improved by more split applications.

Table 4b. Distribution of respondents according to micro nutrients application (Magnesium sulphate, Boron)

Magnesium Sulphate			Boron		
Category (g/palm/yr)	No.	%	Category (g/palm/yr)	No.	%
Not Applied	230	44.57	Not Applied	276	53.49
0 - 250	53	10.27	0 - 50	98	18.99
250 - 500	127	24.61	50 - 100	118	22.87
500 - 750	2	0.39	100 - 150	2	0.39
750 - 1000	86	16.67	150 - 200	5	0.97 >
1000	18	3.49	> 200	17	3.29
Total	516	100.00		516	100.00

7. *Yield:* From the Table 5, it can be observed that, maximum farmers (28.42%) having 3-8 years age plantations were getting the yield 5-10 t/ha, 32.95 per cent farmers of 8-12 years age and 41.67 per cent farmers of more than 12 years age are getting yield 15-20 t/ha implies that yield level is increasing as the age of the palms are increasing.

7. *Correlation between yield and adoption of practices:* From Table 6a, it can be indicated that age, application of Potassium and Magnesium Sulphate fertilizers and number of splits the fertilizers have shown significant effect on yield of oil palm. Quantity of

Table 5 Distribution of Farmers based on Oil Palm Fresh Fruit Bunch yield.

Age	FFB Yield (t/ha)														Total	
	<= 5		5 - 10		10 - 15		15 - 20		20 - 25		25 - 30		> 30			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
3 - 8	30	16.39	52	28.42	45	24.59	40	21.86	15	8.20	0	0.00	1	0.55	183	100
8 -12	9	3.45	28	10.73	60	22.99	86	32.95	63	24.14	6	2.30	9	3.45	261	100
>12	2	2.78	8	11.11	15	20.83	30	41.67	12	16.67	3	4.17	2	2.78	72	100
Total	41	7.95	88	17.05	120	23.26	156	30.23	90	17.44	9	1.74	12	2.33	516	100

Table 6a. Correlation coefficient between adopted practices and yield

Independent Variables	Yield	
	Correlation	Probability > |*r*|
Age	0.4037	<0.0001
Nitrogen	0.0593	0.1787
Phosphorus	0.0856	0.0520
Potassium	0.1800	<0.0001
Magnesium Sulphate	0.1951	<0.0001
Boron	0.0124	0.7794
Fertilizer Split	0.2153	<0.0001

Table 6b. Correlation coefficient between irrigation interval and yield for different irrigation systems

Irrigation System	Irrigation Interval vs Yield	
	Correlation	Probability > |*r*|
Basin	-0.1297	0.0109
Flooding	-0.0544	0.8008
Drip	0.0026	0.9816
Microjet	0.1142	0.5868

Fig. 1 Rate of Adoption of Oil Palm in India

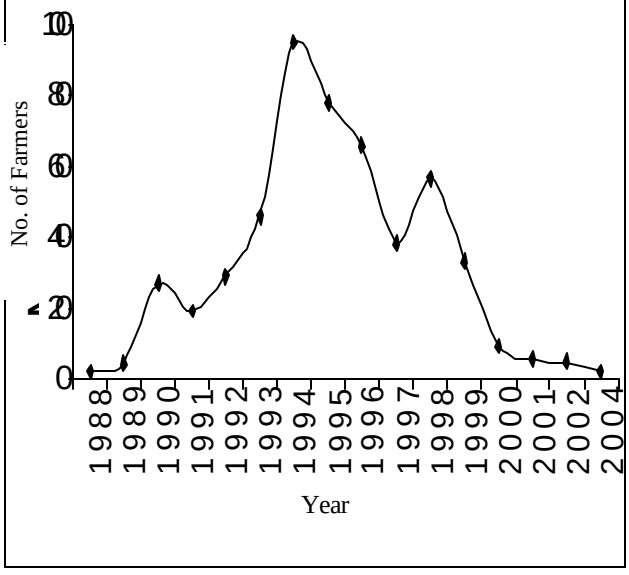

Table 6c. Correlation coefficient between quantity of manure and yield for different Manures

Manure	Quantity of Manure vs Yield	
	Correlation	Probability > |*r*|
Farm Yard Manure	0.1422	0.0037
Poultry Manure	-0.1418	0.6141
Vermi Compost	0.0987	0.8746

Table 6d. Relationship among FFB yield and adopted practices in India

Variable	Estimate	SE	Prob > |t|	R^2*	VIF
Intercept	2.0595	1.1739	0.0800		0.0000
Age	0.9706	0.0942	<0.0001	0.1630	1.0070
No. of Fert.Splits	0.9812	0.2423	<0.0001	0.2066	1.1133
Quantity of Manure	0.0221	0.0060	0.0002	0.2324	1.0233
Magnesium Sulphate	0.0011	0.0006	0.0580	0.2423	1.2448
Potassium	0.0004	0.0003	0.1005	0.2463	1.2060
C(p)= 7.93	*Cumulative R^2 value after entering the variable into the model.				

Nitrogen, Phosphorus and Boron fertilizers did not have any significant influence on yield of oil palm in India under irrigated condition. Correlation between irrigation interval (days) for basin system of irrigation and yield was found negative and significant (Table 6b), which implied that higher yield may be possible with decreasing irrigation interval. Further, quantity of manure (in case of farm yard manure) was found to be significantly and positively correlated with yield (Table 6c). The above explained data was subjected to stepwise multiple regression analysis and the results are summarized in Table 6d. The estimated coefficients imply that increase in age of palm, number of fertilizer splits, quantity of manure, Magnesium Sulphate and Potassium application leads to increased oil palm FFB yield.

8. Practice wise adoption: Though the rate of adoption over the period (1988-2004) showed normal distribution (Fig. 1), from the Table 7a results indicated that adoption

gap (>45%) exists in application of Potassium followed by manure quantity (43.15%), Nitrogen and Phosphorus application (>42%), Magnesium application (31.85%), Boron application (27.13%), number of fertilizer splits (26.49%) and irrigation intervals (20.54%). The adoption gap can be reduced by creating awareness about the critical inputs required by the plant, their availability and judicious application to achieve higher yields. Developmental personnel may consider these above points and render required services to farmers to adopt critical practices to get higher yields.

9. Adoption gap: Results from the Table 7b reveals that 35 per cent gap exists in adoption of practices by the farmers. This calls for an urgent need to adopt critical practices which contribute for higher and sustainable yields.

Table 7a. Practice wise adoption index and gap

S. No.	Practice	Adoption Index (%)	Adoption Gap (%)
1	Irrigation Interval	79.46	20.54
2	Quantity of Manure	56.85	43.15
3	Application of Nitrogen	57.36	42.64
4	Application of Phosphorus	57.75	42.25
5	Application of Potassium	54.84	45.16
6	Application of MgSO4	68.15	31.85
7	Application of Boron	72.87	27.13
8	Fertilizer Splits	73.51	26.49

Table 7b Adoption gap of oil palm farmers in India

S. No.	Particulars		%
1	Obtainable Maximum Score	24.00	-
2	Average Score Obtained	15.62	65.10
3	Average Gap	8.38	34.90

CONCLUSION

The area under oil palm was steadily increased during the year 1993 to 1998. Efforts are required to be put for sustained area expansion. It is also required to increase the productivity of the plantations. Majority of the farmers were following basin method of irrigation to irrigate the oil palm plantations. However, it is advised to switch over from basin irrigation to drip/ microjet irrigation for efficient utilization of water resources and it is advised to give frequent irrigations with less quantity of water in case of basin irrigation. Most of the farmers were not applying the recommended dose of chemical fertilizers and organic manures. Hence suggestions were made to apply fertilizers urea, single super phosphate and murate of potash @ 2.6, 3.75 and 2 kg ha-1, respectively to meet the required quantity in 4 equal splits per year. Majority of the farmers were not applying the micronutrient fertilizers like Boron and Magnesium. Farmers were advised to apply Magnesium Sulphate @ 500g for all the palms every year and Boron @ 100g/ palm/year when the deficiency symptoms are noticed in the field. In order to make the farmers in realizing the higher yields with more net returns, it is advised to apply the fertilizers based on leaf nutrient analysis and soil test values. Imbalance application of major and micronutrients could be avoided by the judicial and rational application of fertilizers along with required quantity of organic manures. One of the major adoption gap is the frequency of irrigation may be due to irregular power supply, which needed to be seriously looked into. There is a great need to provide uninterrupted power supply to make best use of micro irrigation systems. The results of the present study had clearly indicated the adoption gaps, gap between actual and potential yields and also helped to identify the priorities and gaps. This calls for an action plan to identify the major thrust areas (electricity, Irrigation and fertilizers) to be taken care and adopt the recommended practices to achieve sustainable and potential yields. This requires support, cooperation and coordination of all the agencies involved in oil palm development programme in India.

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