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## Evaluation of new cross combinations of oil palm for growth and yield attributes in Tungabhadra command area of Karnataka

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**Abstract**

High yielding hybrids play an important role in increasing the yield and oil in the oil palm. With a view to develop and evaluate high yielding new oil palm cross combinations, a field experiment was conducted in AICRP On Palm (Oil Palm), ARS, Gangavathi, UHS, Bagalkot (Karnataka) to evaluate the ten new hybrid cross combinations of oil palm (NRCOP 1 to 10). Hybrids were planted during 2007 in a replicated trial. Managed with recommended package of practice (1200:600:1200 g N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O per plant per year and irrigation based on potential evapotranspiration). The average data of all five years indicated that, significantly higher annual rate of leaf production recorded with NRCOP-2 & 1, 4 (18.10) & (18.02) over NRCOP-7 & 6 (16.76) & (16.86) and it was on par with NRCOP-10(17.88) & NRCOP-3(17.40) hybrid combinations. Numerically higher sex ratio was recorded with NRCOP- 7 (0.66) over other hybrid combinations. With regard to FFB yield (average of all five years) the hybrid cross combination NRCOP- 4 recorded significantly higher FFB yield (14.66 tha<sup>-1</sup>) over, NRCOP-3 (10.98 tha<sup>-1</sup>), NRCOP-1(11.22 tha<sup>-1</sup>) and it was on par with remaining hybrids and similar results in Bunch weight and number of bunches per palm was recorded. Pooled data on FFB yield for 2013-2017 indicated that, the hybrid combination NRCOP - 4 recorded higher FFB yield (14.66 tha<sup>-1</sup>) at Gangavathi and appeared to have better prospects for adaptation under Tungabhadra command area.

**Keywords:** oil palm, growth, FFB yield, cross combinations, dura x pisifera, tenera hybrids

**Introduction**

The oil palm (*Elaeis guineensis* Jacq.) is the highest edible oil yielding crop up to 4 - 6 MT of mesocarp oil and 0.4 to 0.6 MT of palm kernel oil per hectare per annum. It is the crop that has a greater advantage in the productivity per hectare that is much higher than that of any major oil producing crop, thus cutting the cost of land infrastructure, maintenance and harvesting. It is a crop of the future and source of health and nutrition, value addition, waste utilization, eco-friendly, diversification, import substitution, co-generation and sustainability. Realizing the potential of the crop in bridging the shortage edible oil requirement in India, the cultivation of oil palm has got considerable attention from planners, researchers and farmers. The country has got potential of 2 million ha for cultivation of the crop against the present area coverage of 2.63 lakh ha (Rethinam, 2014)<sup>[6]</sup>.

The global production of vegetable oils has made tremendous impact, of which progress made by palm oil, soybean, rapeseed and sunflower oil is worth mentioning. Malaysia and Indonesia have played a dominant role in the production of palm oil. The total vegetable oil production has increased from 16.07 million tons in 1960 to 81.83 million tons in 1998 and to 159.43 million tons in 2013 with major contribution from palm oil (56.21 million MT) (Rethinam, 2014)<sup>[6]</sup>.

High yielding hybrids play an important role in increasing the yield and oil productivity in the oil palm. Performance of Dura x Pisifera combinations at Gangavathi revealed that maximum number of bunches and weight of FFB were recorded with the combination 131 D x 435 P and 345D x 577 P, respectively. In the present study, different cross combinations of Dura x Pisifera developed from ICAR - IIOPR were evaluated for their yield performance under medium black soils of Tungabhadra command area (Gangavathi).

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## Materials and Methods

The present study on 'Evaluation of new cross combinations of oil palm for growth, yield and yield attributes was carried out at AICRP on Palms (Oil Palm), Centres *viz.*, ARS Campus, Gangavathi (University of Horticultural Sciences, Bagalkot), under medium black soils of Tungabhadra Command area of Karnataka, India.

The weather data of the centres is presented in table 1 and depicted in Figure 1. The mean rain fall of the Gangavathi station for a period of 27 years is about 575 mm distributed over 35-36 rainy days. During the experimental years an amount of 485.76 mm rainfall received. Peak rainfall was observed during the month of August and September (93.97 mm & 121.20 mm). Higher mean monthly an average maximum temperature was observed in the month of April & May (36.9°C & 37.3°C), while mean an average minimum temperature was the lowest in the months of December (16.6°C) & January (17.0°C).

The experiment has been laid out in a RBD design with ten different new hybrid cross combinations developed from ICAR-IIOPR, Regional Station, Palode and were planted during 2007 in three replications and 6 palms per treatment. The recommended package of practice of 1200:600:1200 g N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O per plant per year and irrigation based on potential evapotranspiration were followed.

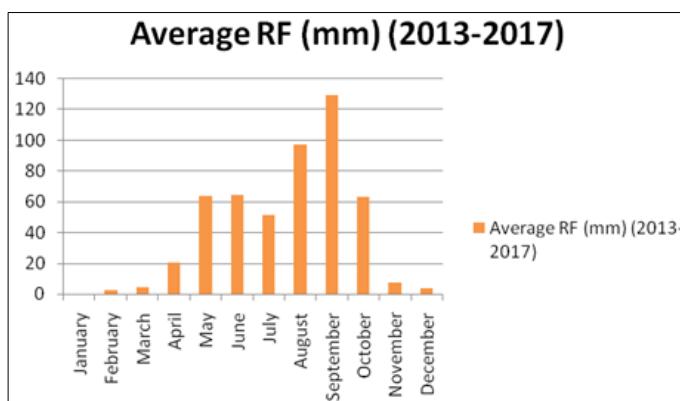
The observations (growth characters, FFB yield and yield attributes) were recorded during 2013 to 2017 were subjected to statistical analysis and were interpreted. The following are the different cross combinations with their parentage.

### Hybrids cross combinations – (Locations: Gangavathi)

S. No	Cross combinations	Sl. No	Cross combinations
1	NRCOP-1 (78D x 435P)	6	NRCOP-6 (173D x 435P)
2	NRCOP-2 (90D x 577P)	7	NRCOP-7 (183D x 577P)
3	NRCOP-3 (158D x 116P)	8	NRCOP-8 (70D x 577P)
4	NRCOP-4 (131D x 435P)	9	NRCOP-9 (28D x 435P)
5	NRCOP-5 (5D x 577P)	10	NRCOP-10 (345D x 577P)

**Table 1:** Rainfall data at ARS, Gangavathi during 2013 to 2017

S. No.	Month	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Rainfall (mm)	Average RF (mm) (2013-2017)
		2013	2014	2015	2016	2017	
1	January	0.00	0.00	0.00	0.00	0.00	0.00
2	February	0.00	13.00	0.00	0.00	0.00	2.60
3	March	0.00	13.00	2.80	0.00	6.30	4.42
4	April	5.50	9.40	87.90	0.00	0.08	20.58
5	May	102.00	128.80	21.00	46.20	21.10	63.82
6	June	96.50	38.00	29.40	134.90	22.30	64.22
7	July	34.50	117.90	3.50	68.30	33.30	51.50
8	August	22.50	192.50	31.90	48.00	190.90	97.16
9	September	118.50	80.00	196.70	72.40	180.90	129.70
10	October	108.50	132.00	0.00	1.00	74.40	63.18
11	November	2.00	28.20	5.60	0.00	0.00	7.16
12	December	0.00	11.00	6.60	2.30	0.00	3.98
Total		490.00	763.80	385.40	373.1	530.00	508.32
Average		61.25	69.43	42.82	53.30	66.25	42.36



**Fig 1:** Average rainfall (mm) data during 2013-2017

## Results and Discussion

### Annual leaf production

Table 2 shows that, pooled data of five years (2013 to 2017) indicated that, the annual rate of leaf production differed significantly among the different hybrids. The significantly higher annual rate of leaf production recorded with NRCOP-2 & 1, 4 (18.10) & (18.02) over NRCOP-7, 6 (16.76), (16.86) and it was on par with NRCOP-10 (17.88) & NRCOP-3 (17.40) hybrid combinations at Gangavathi. The results were in conformity with Sanjeevraddi, *et al* (2016)<sup>[7]</sup> Sunil Kumar,

*et al* (2015)<sup>[8]</sup> tested in inter-specific hybrids and Pillai, *et al* (2005)<sup>[5]</sup>.

### Sex Ratio

Table 2 shows that, pooled data of five years indicated that, the sex ratio indicated that non significant difference among the different hybrids. Numerically higher sex ratio was recorded with NRCOP-7 (0.66) and it was lowest with NRCOP-3 & 6 (0.60) hybrid combinations at Gangavathi. The results were in conformity with Sanjeevraddi, *et al* (2016)<sup>[7]</sup>.

**FFB yield parameters**

Table 3 shows that, pooled data of five years indicates the significantly difference was found among the hybrid combinations. The genotype NRCOP- 4 recorded the significantly higher FFB yield (14.66 t ha<sup>-1</sup>) over NRCOP-3 (10.98 t ha<sup>-1</sup>), NRCOP-1 (11.22 t ha<sup>-1</sup>) and NRCOP-6(12.04 t ha<sup>-1</sup>) it was on par with remaining hybrids at Gangavathi.

Mandal *et al.* 2011 [3] opined that the highest FFB yielding palm (206.5 kg) was found in ISC-2 inter-specific hybrid. The variation in the yield across the location is due to favourable environmental conditions, soil nutrient status as well as management practices. The results were in conformity with Sanjeevraddi, *et al* (2016) [7].

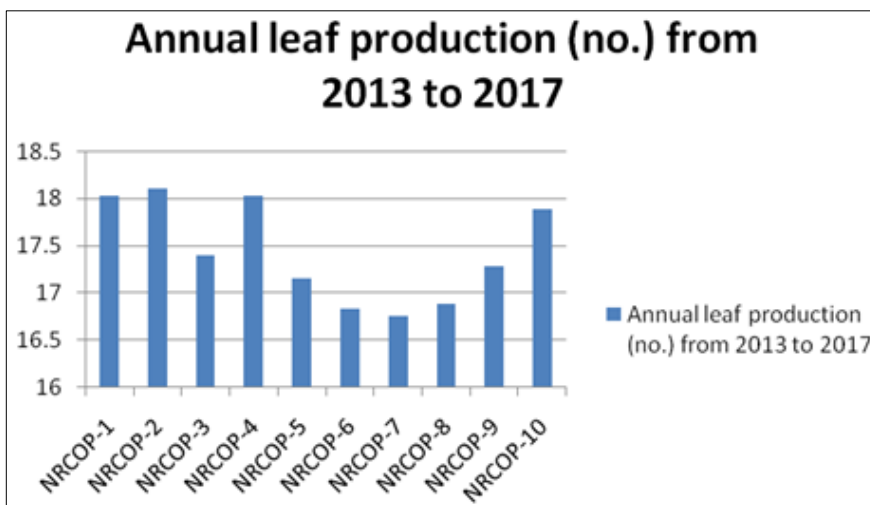


Fig 2: Annual leaf production per palm of different oil palm hybrid cross combinations during 2013-2017

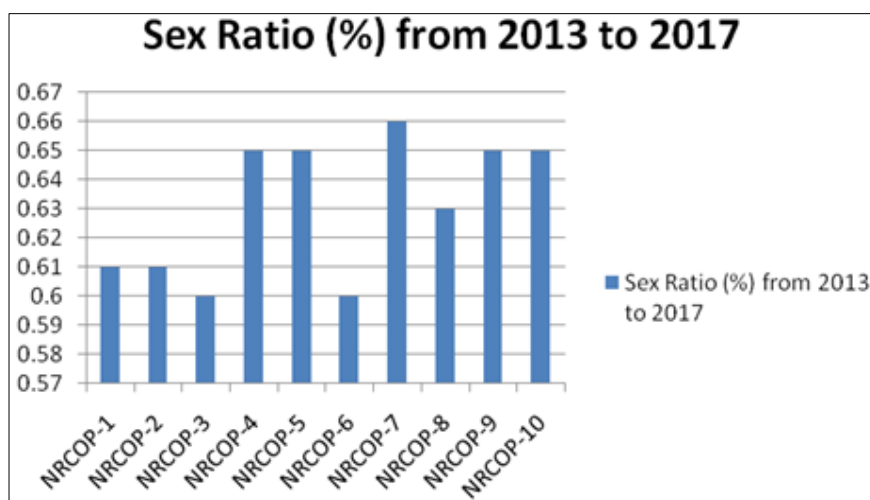


Fig 3: Sex ratio of different oil palm hybrid cross combinations during 2013-2017

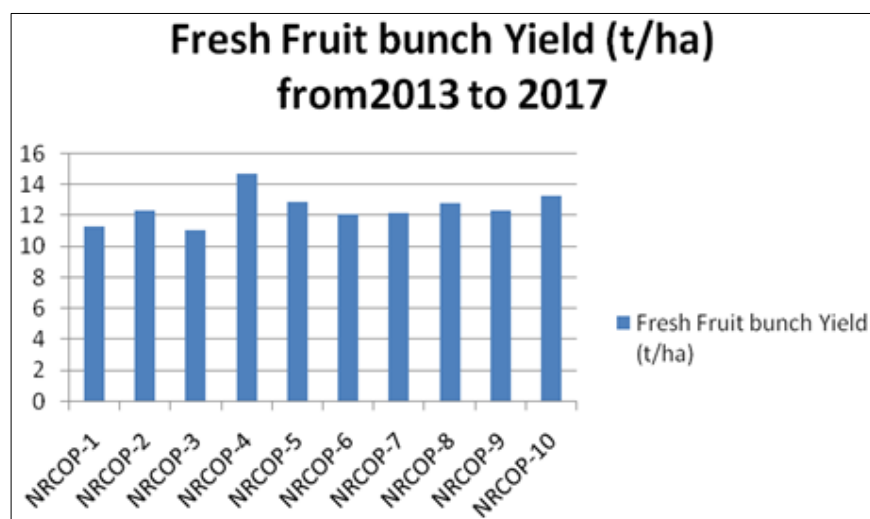


Fig 4: FFB yield of different oil palm hybrid cross combinations during 2013-2017

The average data of all five years indicated that, the hybrid cross combination NRCOP- 4 recorded the significantly higher FFB yield (14.66 t ha<sup>-1</sup>) over NRCOP-3, NRCOP-1, NRCOP-6 and it was on par with remaining hybrids. Similar superior performance of Dura x Pisifera combinations at Gangavathi revealed that maximum number of bunches and weight of FFB were recorded with the combination 104 D x 291 P and 109D x 291 P (Sanjeevraddi, *et al*; 2016) <sup>[7]</sup> (Mastana Reddy *et al*; 2009) <sup>[4]</sup> respectively.

**Economics:** During the last five years i.e 2013 to 2017 data shows that gross return (GR) was significantly differed among the hybrids. The hybrid NRCOP-4 was recorded the highest gross return (Rs.117280 Rs/ha) against all hybrid cross combinations. The lowest gross return (Table 3) was recorded by NRCOP-3(87840 Rs/ha). The cost of cultivation is calculated by taking average of five years expenditure.

Among the hybrids the cost of cultivation was did not differed significantly (Table 3). However, the numerically the hybrid NRCOP-6 (42460 Rs/ha) recorded the highest cost of cultivation against all hybrid cross combinations and lowest was recorded with the hybrid NRCOP-4 (42100 Rs/ha) (Table 3).

Among the different hybrid combinations the net return was differed significantly. However, the hybrid NRCOP-4 (75180 Rs/ha) was recorded significantly the highest net return among the all hybrid cross combinations and the lowest net return was recorded by the hybrid NRCOP-3 (45540 Rs/ha) and higher B: C ratio was recorded by NRCOP-4 (2.78) as compared to other genotypes tested. Hence, NRCOP-4 is found to be recommended as good monetary returns in oil palm under Tungabhadra command area of Karnataka (Table 3).

**Table 2:** Vegetative growth parameters of different oil palm hybrids.

Hybrids	Annual leaf production (nos.)						Sex ratio (%)					
	2013	2014	2015	2016	2017	Pooled	2013	2014	2015	2016	2017	Pooled
NRCOP-1	17.7	18.7	17.9	18.7	17.1	18.02	0.59	0.63	0.69	0.63	0.51	0.61
NRCOP-2	18.7	19.1	18.1	18.3	16.3	18.10	0.55	0.62	0.63	0.66	0.61	0.61
NRCOP-3	17.2	17.9	17.8	18.5	15.6	17.40	0.53	0.68	0.58	0.66	0.58	0.60
NRCOP-4	18.2	18.9	18.4	19.0	15.6	18.02	0.63	0.70	0.64	0.68	0.62	0.65
NRCOP-5	18.1	17.0	18.0	17.8	14.9	17.16	0.62	0.71	0.66	0.69	0.56	0.65
NRCOP-6	16.7	17.3	17.0	18.3	15.0	16.83	0.61	0.69	0.53	0.61	0.58	0.60
NRCOP-7	16.8	17.9	17.5	16.8	14.8	16.76	0.65	0.71	0.60	0.73	0.61	0.66
NRCOP-8	17.9	17.7	17.0	17.0	14.8	16.88	0.55	0.72	0.68	0.66	0.56	0.63
NRCOP-9	17.4	18.5	17.5	18.1	14.9	17.28	0.54	0.70	0.69	0.74	0.60	0.65
NRCOP-10	19.7	18.4	17.1	18.6	15.6	17.88	0.63	0.67	0.62	0.73	0.60	0.65
S. Em±	1.4	0.46	0.42	0.60	0.44	0.50	0.39	0.43	0.31	0.12	3.12	0.02
CD (P=0.05)	NS	1.35	1.25	1.78	1.32	1.60	1.17	NS	9.05	0.33	9.28	NS

**Table 3:** Fresh Fruit Bunch yield attributes and economics of (Average five years 2013 to 2017) different oil palm hybrids.

Hybrids	Fresh Fruit Bunch Yield (t/ha)						Economics of oil palm cultivation			
	2013	2014	2015	2016	2017	Pooled	G R (Rs/ha)	COC (Rs/ha)	N R (Rs/ha)	B C Ratio
NRCOP-1	10.4	12.3	11.8	11.3	10.3	11.22	89760	42250	47510	2.12
NRCOP-2	10.0	11.5	11.9	14.6	13.5	12.30	98400	42300	56100	2.32
NRCOP-3	6.0	10.6	11.6	13.7	13.0	10.98	87840	42300	45540	2.07
NRCOP-4	10.6	14.6	16.1	16.4	15.6	14.66	117280	42100	75180	2.78
NRCOP-5	8.0	14.3	13.1	14.9	13.8	12.82	102560	42350	60210	2.42
NRCOP-6	7.3	14.0	14.7	12.6	11.6	12.04	96320	42460	53860	2.26
NRCOP-7	8.4	13.2	9.6	15.3	14.2	12.14	97120	42350	54770	2.29
NRCOP-8	8.7	13.0	14.5	14.2	13.3	12.74	101920	42220	59700	2.41
NRCOP-9	8.0	11.7	13.6	14.6	13.5	12.28	98240	42300	55940	2.32
NRCOP-10	8.7	12.1	14.1	16.1	15.1	13.22	105760	42350	63410	2.49
S. Em±	1.0	0.86	0.80	0.90	0.7	0.96	2520	225	2852	0.20
CD (P=0.05)	2.8	2.54	2.37	2.70	2.22	2.88	7560	NS	8556	0.60

## Conclusion

The evaluation study of tenera hybrids over the five years indicated that at the age of ten years, the hybrid cross combination NRCOP - 4 recorded higher FFB yield and higher yield attributes, monetary returns (14.66 t ha<sup>-1</sup>) at Gangavathi and appeared to have better prospects for adaptation under Tungabhadra command area (Karnataka, India). This study will have to be continued for few more years to evaluate the stabilised yield of the hybrids across the different agro-climatic regions of the country India.

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