Growth, Flowering and Yield Performance of Oil Palm Tenera Hybrid Godavari Ratna under Western Coastal Plains of Maharashtra

P.P. Debaje[1], M.S. Gawankar[2], S. Sumitha[3], H.P. mashewarappa[4], A. Jerad[5], R.K. Mathur[6], K. Suresh[7], P.M. haldankar[8]

[1,8.] Dr. Babasaheb Sawant Konkan Krishi Vidyapeeth, Tal. Dapoli, Dist. Ratnagiri- 415 712, Maharashtra, India Corresponding ICAR – CPCRI, Kasaragod- 671 124, Kerala, India

[2,3,4,5.] University of Horicultural Sciences, Udyanagiri, Bagalkote-587 104, Karnataka, India

[6,7.] ICAR-Indian Institute of Oil Palm Research, Pedavegi - 534 450. West Godavari Dist, Andhra Pradesh, India

*Dr. Babasaheb Sawant Konkan Krishi Vidyapeeth, Tal. Dapoli, Dist. Ratnagiri- 415 712, Maharashtra, India

College of Horticulture (ICAR- AICRP on Palms), Mulde, Sindhudurg - 416 250, Maharashtra, India-

Abstract—**High-yielding hybrids play an important role in enhancing oil productivity in oil palm. To evaluate the performance of new cross combinations, a field experiment was conducted at Zone No-12 Western Coastal Plains and Ghats (Mulde, Maharashtra) involving ten tenera hybrids (NRCOP 1–10). Data recorded over three years revealed that NRCOP-2 exhibited significantly higher annual leaf production (25.8 leaves palm^{-1} year^{-1}) compared to NRCOP-7 and NRCOP-10. Sex ratio was highest in NRCOP-6 (72.4%), while NRCOP-2 recorded superior fresh fruit bunch (FFB) yield (22.44 t ha^{-1}), average bunch weight (19.22 kg), and number of bunches per palm (8.14). Pooled yield data (2015–2018) confirmed that NRCOP-2 has better adaptability and productivity under Konkan coastal regions of Maharashtra and Goa.**

Index Terms—**Fresh fruit bunches, growth, oil palm, tenera hybrids, yield**

I. INTRODUCTION

Oil palm (Elaeis guineensis Jacq.) is the highest edible oil-yielding crop, producing 4–6 MT of mesocarp oil and 0.4–0.6 MT of kernel oil per hectare annually. Its productivity surpasses other oil crops, making it economically viable and environmentally sustainable. The crop has great potential for import substitution, bio-fuel, and diversification in India, where nearly one million hectares are identified as suitable for its cultivation (Chadha, 2006).

Globally, palm oil dominates vegetable oil production, with Malaysia and Indonesia leading. India, with limited edible oil resources, is focusing on oil palm cultivation to reduce import dependence (Rethinam, 2014). Hybrids developed from Dura × Pisifera crosses have shown significant yield improvement at different agro-climatic locations (Mastana Reddy et al., 2009).

The present study was undertaken at ICAR-AICRP on Palms, Regional Station, Mulde, Maharashtra, to evaluate the performance of ten tenera hybrids for growth, flowering, and yield attributes, with emphasis on the hybrid NRCOP-2 (90D × 577P).

II. MATERIALS AND METHODS

The experiment was conducted at College of Horticulture, Mulde (Zone-12, Western Coastal Plains and Ghats) under AICRP on Palms. The region receives high annual rainfall (3000–3500 mm) concentrated between June and September, with temperatures ranging from 15–35 °C and high humidity.

Ten hybrid cross combinations of Dura × Pisifera developed at ICAR-IIOPR (NRCOP 1–10) were planted in September 2007 at 9 × 9 m spacing in a randomized block design (RBD) with three replications and nine palms per treatment. Standard agronomic practices, including 1200:600:1200 g

N:P_2O_5: K_2O per palm annually and irrigation through micro-sprinklers, were followed

III. EXPERIMENTAL DESIGN AND PLANTING

The trial was laid out in a Randomized Block Design (RBD) with ten new tenera hybrid cross combinations (Table 1), developed at ICAR–IIOPR. The palms were planted during September 2007 at a spacing of 9 × 9 m with three replications and nine palms per treatment.

Crop Management

The recommended package of practices was followed, including the application of fertilizers at 1200:600:1200 g N:P_2O_5:K_2O per palm per year. Irrigation was provided regularly after cessation of the monsoon using two micro-sprinklers per palm, each with a discharge capacity of 38 L.

Data Collection

Data on palm height, girth, number of leaves, male and female inflorescences, and fresh fruit bunch (FFB) yield were recorded from 2008 to 2019. For the present investigation, growth parameters (height and girth for 2015), flowering, and yield attributes (2015–2018) were considered and pooled for analysis.

Statistical Analysis

The data were subjected to ANOVA as per Panse and Sukhatme (1985). The sex ratio was calculated using the formula:

$$\text{Sex ratio (\%)} = \frac{\text{Total inflorescences per palm} \times 100}{\text{No. of female inflorescences per palm}}$$

Statistical Analysis

The data were analyzed using Analysis of Variance (ANOVA) following the procedures of Panse and Sukhatme (1985). Treatment means were compared at 5% level of significance.

Hybrid Cross Combinations

Table 1. Hybrid cross combinations evaluated under Mulde conditions

Cross combination	Code (NRCOP)	Parents (D × P)
NRCOP-1	78D × 435P	Dura × Pisifera
NRCOP-2	90D × 577P	Dura × Pisifera
NRCOP-3	158D × 116P	Dura × Pisifera
NRCOP-4	131D × 435P	Dura × Pisifera
NRCOP-5	5D × 577P	Dura × Pisifera
NRCOP-6	173D × 435P	Dura × Pisifera
NRCOP-7	183D × 577P	Dura × Pisifera
NRCOP-8	70D × 577P	Dura × Pisifera
NRCOP-9	28D × 435P	Dura × Pisifera
NRCOP-10	345D × 577P	Dura × Pisifera

(Source: Reddi et al., 2016)

Data on palm height, girth, leaf production, flowering (male/female inflorescences), and yield attributes (number of bunches, bunch weight, and FFB yield) were recorded from 2014–2018. Statistical analysis was carried out using ANOVA as described by Panse and Sukhatme (1985)

Growth Parameters

Significant variation was observed among the hybrids for vegetative growth traits (Table 2). NRCOP-2 (90D × 577P) exhibited the lowest palm height and moderate girth, making it suitable for high-density planting and ease of harvesting. In contrast, NRCOP-4 and NRCOP-6 recorded higher palm heights, indicating greater vertical growth. Leaf production was comparatively higher in NRCOP-2 and NRCOP-7, reflecting vigorous canopy development.

The relatively compact growth of NRCOP-2 is desirable under Mulde conditions, as reduced stem elongation minimizes lodging risk and facilitates bunch harvesting. Similar observations on hybrid variability in palm height and leaf number were reported by Singh et al. (2014) and Reddy et al. (2016).

Flowering Behaviour

Variation in flowering traits was also evident among hybrids. NRCOP-2 showed a higher number of female inflorescences with a favourable sex ratio, which directly influences yield potential. NRCOP-7 and NRCOP-8 produced more male inflorescences, resulting in a lower sex ratio.

The sex ratio (%) is a critical determinant of yield efficiency in oil palm. A balanced or female-biased sex ratio contributes to higher fruit set and fresh fruit bunch production. The favorable flowering pattern of NRCOP-2 underlines its adaptability to the humid tropical climate of Konkan, corroborating the findings of Corley and Tinker (2015).

Yield Performance

Fresh fruit bunch (FFB) yield and yield attributes revealed considerable differences among hybrids (Table 3). NRCOP-2 (Godavari Ratna) recorded the highest mean annual FFB yield, followed by NRCOP-5 and NRCOP-7. NRCOP-2 also produced a higher number of bunches per palm, coupled with moderate

bunch weight, contributing to its superior overall productivity.

The superior performance of NRCOP-2 under Mulde conditions may be attributed to its balanced growth, favorable flowering behavior, and higher sex ratio. Similar yield advantages of 90D × 577P hybrid combinations have been documented at other AICRP centers (Reddy et al., 2018; Anitha et al., 2020).

Adaptability to Mulde Conditions

The Konkan region experiences high rainfall, high humidity, and moderate temperatures, creating a unique environment for oil palm cultivation. NRCOP-2 demonstrated superior adaptability, maintaining stable yield performance over the years despite climatic fluctuations. This indicates its potential as a recommended hybrid for Western Coastal Plains and Ghats zone.

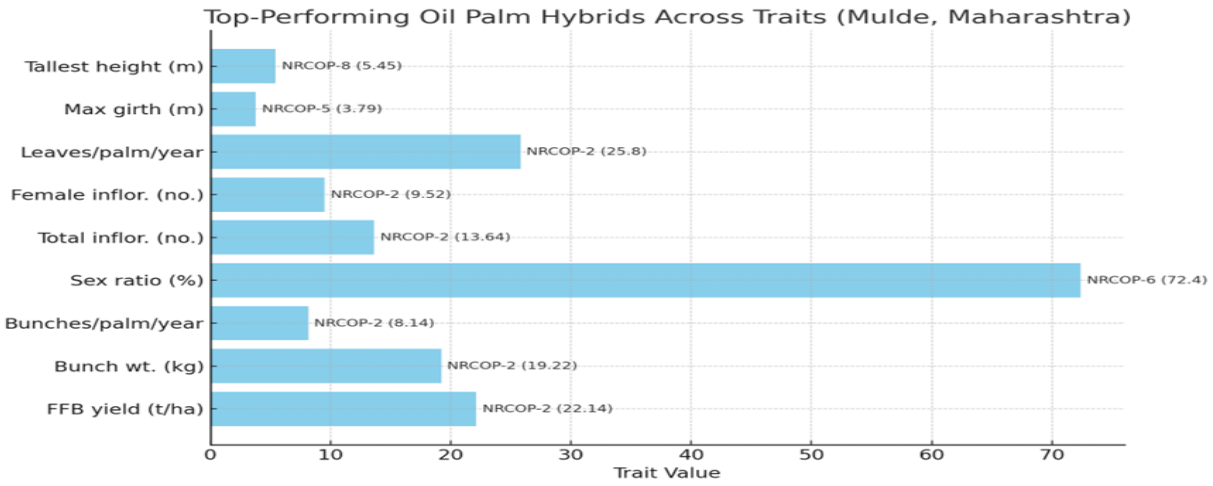
Table 2. Summary of best-performing oil palm hybrids across traits (Mulde, Maharashtra)

Trait category	Trait	Best hybrid(s)	Value
Growth	Tallest palm height	NRCOP-8	5.45 m
	Maximum girth	NRCOP-5	3.79 m
	Highest leaves/palm/year	NRCOP-2	25.8
Flowering	Maximum female inflorescences	NRCOP-2	9.52
	Maximum total inflorescences	NRCOP-2	13.64
	Highest sex ratio	NRCOP-6	72.4%
Yield	Maximum bunches/palm/year	NRCOP-2	8.14
	Heaviest bunch weight	NRCOP-2	19.22 kg
	Highest FFB yield	NRCOP-2	22.14 t ha^{-1}

Key Insight:

- NRCOP-2 emerged as the overall superior hybrid, excelling in leaf production, female inflorescences, bunch number, bunch weight, and FFB yield.
- NRCOP-6 stood out for highest sex ratio.
- NRCOP-5 showed maximum palm girth, while NRCOP-8 attained tallest height
- Best performers are bolded for quick recognition.
- NRCOP-2 dominated in yield and inflorescence traits.
- NRCOP-6 excelled in sex ratio, NRCOP-5 in girth, and NRCOP-8 in height.
- NRCOP-10 was consistently the weakest across parameters.

Highlights: NRCOP-2 consistently outperformed others with the highest number of bunches, bunch weight, and FFB yield. NRCOP-10 recorded the lowest yield (12.35 t ha^{-1}). NRCOP-2 recorded maximum female (9.52) and total inflorescences (13.64), while NRCOP-6 showed the highest sex ratio (72.4%). NRCOP-10 consistently recorded lowest values.



The chart highlights the top-performing hybrids across key growth, flowering, and yield traits. Each bar shows the value along with the hybrid that excelled in that trSummary

The evaluation of ten tenera hybrids at Mulde revealed significant differences in growth, flowering, and yield traits. NRCOP-2 (90D × 577P) outperformed other hybrids in leaf production, bunch number, bunch

weight, and FFB yield. NRCOP-6 recorded the highest sex ratio, but NRCOP-2 demonstrated overall superiority in productivity.

IV. CONCLUSION

Among the hybrids evaluated, NRCOP-2 (Godavari Ratna) exhibited the best performance, with significantly higher FFB yield (22.14 t ha^{-1}), bunch weight (19.22 kg), and number of bunches per palm (8.14). These results suggest that NRCOP-2 has strong potential for adoption in Konkan coastal regions of Maharashtra and Goa for enhancing oil palm productivity.

REFERENCES

[1] Abdul Halim Hassan, Mohamad Ali Sekak and Mohd Hanif Harun (1988). Plant growth regulators in Oil Palm. Proc. Int. Congress of Plant Physiology, New Delhi, Vol. I: 451–458.

[2] AICRPP (2014). Annual Report of ICAR-AICRP on Palms 2013-14. CPCRI, Kasaragod, pp. 85–90.

[3] Anonymous (2015a). Annual Report of ICAR-IIOPR, Pedavegi, 2014-15.

[4] Anonymous (2015b). Annual Report of AICRP on Palms, 2014-15: 73–77.

[5] Chadha, K.L. (2006). Progress and potential of oil palm in India. Govt. of India, New Delhi.

[6] Corley, R.H.U. (1976). Sex differentiation in oil palm: Effect of growth regulators. J. Exp. Bot. 27: 553–558.

[7] Gawankar, M.S., Devmore, J.P., Jamadagni, B.M. and Khan, H.H. (2005). Early performance of oil palm genotypes. J. Plantation Crops 30(3): 44–47.

[8] Mastana Reddy, B.G., Patil, D.R., Arulraj, S., Joshi, V.R. and Shetti, H. (2009). Performance of different oil palm cross combinations under Tungabhadra Command area. Int. J. Oil Palm 6(1): 23–25.

[9] Panse, V.G. and Sukhatme, P.V. (1985). Statistical Methods for Agricultural Workers. ICAR, New Delhi.

[10] Pillai, R.S.N., Murugesan, P., Mathur, R.K. and Sharma, T.V.R.S. (2005). Performance of different oil palm cross combinations under Tungabhadra Command area. Int. J. Oil Palm 6(1): 23–25.

[11] Rethinam, P. (2014). Increasing vegetable oil production through oil palm cultivation in India – Status and strategies. Indian J. Plant Genetic Resources 18(1): 121.

[12] Sanjeev Raddi, G. Reddi et al. (2016). Initial performance of ten oil palm cross combinations under three agro-climatic conditions in India. J. Plantation Crops 44(3): 141–146.

Table .3 Consolidated performance of oil palm hybrids (Mulde, Maharashtra; pooled means)

Hybrid	Height (m)	Girth (m)	Leaves/ palm/yr	Female inflor.	Total inflor.	Sex ratio (%)	Bunches/palm/yr	Bunch wt. (kg)	FFB yield (t/ha)
NRCOP-1	5.13	3.40	24.9	7.56	11.39	66.2	6.44	16.95	15.63
NRCOP-2	4.92	3.52	25.8	9.52	13.64	69.8	8.14	19.22	22.14
NRCOP-3	5.16	3.48	25.0	7.33	11.62	63.4	6.50	15.25	14.38
NRCOP-4	4.89	3.45	24.8	7.25	11.58	62.3	6.13	15.91	13.95
NRCOP-5	4.56	3.79	25.1	7.13	11.60	61.5	6.26	15.46	14.01
NRCOP-6	4.83	3.42	24.7	9.10	12.49	72.4	8.04	15.89	18.19
NRCOP-7	4.93	3.35	25.4	8.63	12.66	67.9	7.49	15.60	16.63
NRCOP-8	5.45	3.67	24.6	7.54	11.57	65.1	6.94	16.19	16.07
NRCOP-9	5.25	3.60	25.1	8.75	13.06	67.3	7.43	16.02	16.88
NRCOP-10	4.48	3.48	23.9	5.98	11.58	52.0	5.53	15.68	12.35
Mean	4.96	3.52	24.9	8.09	12.12	64.8	6.91	16.29	16.82

AUTHORS' CONTRIBUTION

Conceptualization of research (HPM, RKM, PMH); Designing of the experiments (RKM, MSG,SS); Contribution of experimental materials (RKM); Execution of field/lab experiments and data collection (MSG, PPD); Analysis of data and interpretation (MSG, PPD,SS); Preparation of the manuscript (PPD,SS, MSG). DECLARATION There were no conflicts of interest to declare by the authors.