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RESEARCH ARTICLE

Yield potential of oil palm Tenera hybrids in the Cauvery Delta Region of Tamil Nadu

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Abstract

The oil palm (*Elaeis guineensis*) is a major oil-bearing crop cultivated worldwide, known for its highest oil yield per unit area among all oil seeds crops. This study was conducted at the Agricultural Research Station, Tamil Nadu Agricultural University, Pattukkottai, Thanjavur, Tamil Nadu, India, over a period from 2007 to 2024. The objective was to evaluate the yield potential of ten oil palm tenera hybrids, namely NRCOP-1 to NRCOP-10. Key growth and yield parameters included the number of fruit bunches per year, oil content, palm girth, palm height, yearly leaf output and annual production of female and male inflorescences. Among the evaluated hybrids, NRCOP-7 recorded the maximum palm girth (3.91 m), while NRCOP-4 had the tallest palms (5.32 m). NRCOP-2 produced the highest number of fronds (25-60 inches). NRCOP-9 had the highest sex ratio (0.78), fresh fruit bunch yield (206.94 kg per plam) and per hectare yield (29.59 t/ha). Although, NRCOP-1 recorded the highest number of fresh fruit bunches (10.62) per palm, NRCOP-9 surpassed all hybrids in mesocarp oil yield (7.96 t/ha),oil recovery (21.90%). kernel yield (2.83 t/ha) and kernel oil output (1161.83 kg/ha). Among the ten hybrids, NRCOP-9 exhibited the highest fresh fruit bunch yield per palm, followed by NRCOP-10 and NRCOP-8.

Keywords: *Elaeis guineensis*; hybrid; oil palm; tenera

Introduction

The oil palm (*Elaeis guineensis*) belongs to the Arecaceae family and is one of the most important oil yielding crops. The species is native to West Africa and its botanical name reflects its origin - *'Elaeis'* is derived from the Greek word 'elaion,' meaning oil, while *'guineensis'* refers to its presence in the Guinea region. It is a diploid species with 2n=32 chromosomes. It is also commonly known as Nigerian oil palm. In contrast, the American oil palm is classified as *Elaeis oleifera*. Both species are monoecious nature producing separate male and female inflorescences on the same plant. However, *Elaeis odora,* a related but uncultivated species is hermaphrodite in nature (1). Oil palm was brought to India in 1834 and with commercial cultivation beginning in 1970 in the state of Kerala(2). The oil palm is an unbranched, monocotyledonous tree that can grow up to 25-30 meters tall. However, under commercial cultivation, its productive lifespan is typically 25-30 years. Mature trees produce a crown of 40–50 pinnate leaves, each reaching up to six meters in length. Inflorescences develop in leaf axils, with flower buds appearing after 2.5 to 3 years. The oil palm is unique for its high fruit production, which contributes to its economic importance as an oil-yielding crop (3).

Vegetable oils play a crucial role in the human diet by providing essential fatty acids. Sesame, rape seed, mustard, linseed, sunflower, niger, safflower, ground nut and soy are the major sources of the vegetable oils. The top producers of vegetable oil are the United States, China and Brazil. India is ranked fourth in terms of both area and vegetable oil production (4). Over past decade, India has achieved 100% self -sufficiency in production and recorded a 28% growth in the area under cultivation (5). In India, 4.22 lakh hectares of oil palm are grown, yielding 3.60 lakh tonnes of crude palm oil annually. The primary oil palm growing states includes Andhra Pradesh, Telangana, Karnataka, Kerala, Mizoram, Tamil Nadu and Goa. Among all the vegetable oil-bearing crops, oil palm has highest yield potential up to 8 tons per hectare (7). Additionally, it produces 0.4 to 0.6 metric tons of palm kernel oil annually. However, average yields from oil palm holdings in India remains relatively low. Attempts were made to cross Dura and Pisifera types at ICAR-IIOPR, Pedavegi, Eluru, Andhra Pradesh, in an effort to boost the oil palm production. In

Cauvery Delta region, the progenies were planted at Agricultural Research Station, Pattukottai, Thanjavur. The hybrids were examined for growth, fresh fruit bunch yield and oil yield in order to determine which is the best for commercial agriculture.

Materials and Methods

The study was conducted at Agricultural Research Station, Tamil Nadu Agricultural University, Pattukottai, Thanjavur.Ten different tenera hybrids namely, NRCOP-1 (78Dx 435P), NRCOP -2(90D x 577P), NRCOP-3(158D x 116P), NRCOP-4 (131D x 435P), NRCOP-5(5D x 577P), NRCOP-6 (173D x 435P), NRCOP-7(183D x 577P), NRCOP-8(70D x 577P), NRCOP-9 (28D x 435P), NRCOP-10 (345D x 577P) were evaluated. The experiment was established in 2007 using a Randomized Block Design (RBD) with three replications. The soil type was red sandy loam, with a depth of 5 meters. The experiment was conducted under irrigated conditions, utilizing Cauvery River irrigation facilities in coastal region.

Twelve-month-old seedlings were transplanted into 2 cubic-feet pits spaced at 9 m x 9 m in a hexagonal system. Each palm received 200 - 250 litres of water per day during non-monsoon season through drip system. The experiment was established in 2007 using a Randomized Block Design (RBD) with three replications. Growth parameters, yield attributes and oil content in mesocarp and kernel were accessed. The yield attributes were recorded during last five years from 2020 to 2024. Growth parameters such as palm height, palm girth, annual leaf production, annual production of male and female inflorescences and the number of fresh fruit bunches were recorded. The oil content in the mesocarp and kernel was estimated by Soxhlet apparatus method (8). Palm height was measured from the ground level up to the base of 25th leaf and palm girth was measured 60 cm above the ground level and the sex ratio was calculated by following formula (9).

$$\text{Sex ratio} = \frac{\text{Number of female inflorescences}}{\text{Total number of inflorescences}} \times 100$$

Results and Discussion

The experiment's findings show that palm height varied between 4.79 and 5.32 meters (Table 1). NRCOP-10 had the shortest palms (4.79 m), whereas NRCOP-4 recorded the tallest palms (5.32 m), followed by NRCOP-2 (5.29 m), NRCOP-7 (5.25 m), NRCOP-8 (5.22 m) and NRCOP-5 (5.20 m). Oil palms typically exhibit solitary columnar stems with a relatively uniform diameter, which is primarily influenced by formation of phytomer at the apical bud, leading to increased palm height (10). New phytomers generated at the apical bud cause stem elongation, which increases palm height (11). The highest palm girth was recorded in NRCOP-7 (3.91 m), followed by NRCOP-2 (3.89 m) and NRCOP-4 (3.88 m), while NRCOP-1 had the smallest girth (3.61 m), followed by NRCOP-9 and NRCOP-8 (3.64 m). The observed variation in stem girth may be attributed to the genetic differences between the hybrids, which result from crossing dura and pisifera parent lines. The parental influence likely contributes to differences in trunk expansion and biomass accumulation (12).

Leaf production per palm was recorded every three months and the annual total was calculated. The number of leaves produced per year ranged from 23.80 (NRCOP-10) to 25.60 (NRCOP-2), with minimal variation observed among other hybrids (13). The sex ratio is a critical trait influencing fruit bunch production in oil palm, was calculated annually based on the ratio of female to male inflorescences. The value ranged from 0.57 and 0.78. NRCOP-9 had the highest sex ratio (0.78), indicating a greater proportion of female inflorescences, which is beneficial for fruit production. In contrast, hybrid with sex ratio below 0.61 produced more male inflorescences, potentially leading to lower fruit yield. The observed variation among the oil palm hybrids during monsoon may be attributed to genetic heterogeneity as they were derived different male and female parents (14).

The average fresh fruit bunch (FFB) weight was measured annually from 2020 to 2024 (Table 2). In 2020, FFB weight ranged from 12.60 and 15.8 kg, increasing to 16.80 and 21.90 kg in 2024. The overall average bunch weight across hybrids ranged from 14.94 kg to 19.64 kg, with cumulative five year yields ranging from 74.72 kg to 98.20 kg. The annual bunch weight increased by 11.97% and 14.09% in 2021 and 2022 and by 2.11% and 2.17% in 2023 and 2024, respectively. This trend suggests that the bunch weight increased until the age of 15, after which the increased was marginal. The highest bunch weight (15.80 kg, 17.50 kg, 21.20 kg, 21.80 kg, 21.90 kg), mean bunch weight (19.64 kg) and total bunch weight (98.20 kg) among the Tenera hybrids were recorded in NRCOP-9 (28Dx435P) over a five-year period. NRCOP-10 (345D x 577P) was the next high-yielding tenera hybrid, with mean bunch weight (18.81kg) and cumulative bunch weight (90.04) over five years (15.20, 16.42, 20.32, 20.80 and 21.30kg). In NRCOP-1, the mean bunch weight (14.94 kg), total bunch weight (74.72 kg) and low bunch weight over the course of five years (12.60, 13.72, 15.30, 16.30, 16.80 kg) were noted. The superior

Table 1. Growth performance of Oil Palm hybrids during 2024

Name of the Hybrid	Palm height (m)	Palm girth (m)	No. of Leaves/palm /year	Sex ratio
NRCOP -1	5.19	3.61	24.50	0.60
NRCOP -2	5.29	3.89	25.60	0.57
NRCOP -3	5.04	3.78	24.25	0.57
NRCOP -4	5.32	3.88	24.80	0.58
NRCOP -5	5.20	3.80	25.40	0.61
NRCOP -6	5.04	3.79	24.50	0.59
NRCOP -7	5.25	3.91	24.50	0.59
NRCOP -8	5.22	3.64	24.80	0.57
NRCOP -9	4.83	3.64	24.80	0.78
NRCOP -10	4.79	3.84	23.80	0.57
S Ed	0.12	0.25	0.38	0.11
CD 5%	0.24	0.49	0.77	0.20

Table 2. Average fresh fruit bunch (FFB) weight (kg) of Oil Palm hybrids during last five years (2020- 2024)

Hybrids	FFB weight (kg) 2020	FFB weight (kg) 2021	FFB weight (kg) 2022	FFB weight (kg) 2023	FFB weight (kg) 2024	Mean FFB weight (kg)	Cumulative FFB weight (kg)
NRCOP -1	12.60	13.72	15.30	16.30	16.80	14.94	74.72
NRCOP -2	15.20	16.92	18.07	18.50	18.80	17.50	87.49
NRCOP -3	14.90	16.02	18.20	18.31	18.50	17.19	85.93
NRCOP -4	14.40	15.35	17.41	17.94	18.25	16.67	83.35
NRCOP -5	13.30	15.50	17.25	17.31	18.25	16.32	81.61
NRCOP -6	13.00	14.25	16.32	16.70	17.50	15.55	77.77
NRCOP -7	12.80	14.58	17.80	18.00	18.25	16.29	81.43
NRCOP -8	12.30	15.90	19.90	20.04	20.25	17.68	88.39
NRCOP -9	15.80	17.50	21.20	21.80	21.90	19.64	98.20
NRCOP -10	15.20	16.42	20.32	20.80	21.30	18.81	94.04
Mean	13.95	15.62	18.18	18.57	18.98	17.06	85.29
S. Ed	0.12	0.18	0.20	0.16	0.17	0.14	0.88
CD (P=0.05)	0.24	0.36	0.40	0.31	0.34	0.28	1.66

* FFB: Fresh Fruit Bunch

performance of NRCOP 9 may be attributed to its genetic background, derived from the cross between female parent 28Dura and male parent 435Pisifera. The recombination of genetic material between may have resulted in improved photosynthetic efficiency and greater oil accumulation in fruits, ultimately contributing to increased bunch weight (15).

The number of fresh fruit bunches (FFB) per palm increased steadily up to the 13th year of growth, reaching an average of 9.59 bunches per palm (Table 3). After this period, the annual increase slowed, stabilizing at approximately 10.57 bunches per palm. In 2020, the number of bunches per palm ranged from 7.40 to 9.20, which increased from 10.60 to 11.60 in 2024. The cumulative total number of fresh fruit bunch ranged from 46.24 to 53.09, with a mean range of 9.25 to 10.62. NRCOP-1 recorded the highest number of bunches per palm (10.62), followed by NRCOP-9 (10.42), NRCOP-7 (10.37), NRCOP -5 (10.30), NRCOP-8 (10.25), NRCOP-10 (10.20) and NRCOP-6 (10.19). In contrast, NRCOP-3 (9.68), NRCOP-4 (9.32) and NRCOP-2 (9.25) recorded the lowest number of bunches. A high number of bunches is positively correlated with the production of female inflorescences, which is influenced by climatic factors such as rainfall. The superior performance of NRCOP-9 (28Dura × 435Pisifera) may be attributed to its genetic makeup, which is likely supports more stable female inflorescence production, even under fluctuating climatic conditions, resulting in a higher number of fruit bunches (16).

The mean and cumulative yield of fresh fruit bunches (FFB) per palm (Table 4) increased significantly up to the year 2022, with growth rates of 31% and 28% in the 15th year of planting. However, the rate of increase slowed to 5.7% in the 16th year (2023) and 3.5% in the 17th year (2024), indicating that yield stabilization occurs around 15 years after planting. Among the hybrids, NRCOP-9 consistently recorded the highest yield per palm throughout the course of the five years (138.60 kg, 173.25 kg, 222.60 kg, 246.34 kg and 254.04 kg). Followed by NRCOP-10 (120.10kg, 160.92kg, 219.45kg, 234.00kg, 239.63kg) and NRCOP-8 (159.32 kg, 211.94 kg, 224.48 kg, 230.85 kg), NRCOP-4 recorded the lowest bunch weights, which were 111.40 kg, 135.85 kg, 173.23 kg, 179.37 kg and 182.50 kg. In terms of mean and cumulative yield per palm over five years, , NRCOP-9, NRCOP-10 and NRCOP-8 had high mean and cumulative yields per palm (206.94 kg, 194.8 kg and 184 kg) and 1034.83 kg, 974.10 kg and 924.59 kg, respectively. NRCOP 9 has a more fresh fruit bunch creation per palm owing to the increased quantity of fruit bunches and weight. The superior performance of NRCOP-9 may be attributed to its higher number of fruit bunches per palm and larger bunch weight, which are likely influenced by its genetic combination (28Dura × 435Pisifera) (17).

In 2019–20, the FFB yield ranged from 14.10 to 19.80 t/ ha, increasing to 26.10-36.33 t/ha by 2024 (Table 5). Among the hybrids, NRCOP-9 consistently exhibited the highest yield, increasing from 19.80 t/ha in 2020 to 36.33 t/ha in 2024, followed by NRCOP-10 and NRCOP-8. In contrast, NRCOP-4 recorded the lowest yields, ranging from 15.90 t/ha in 2020 to 26.10 t/ha in 2024. Yield growth was most significant up to 15 years of age, with an increase of 31.66% observed in the 14th year and 28.45% in the 15th year. However, the rate of increase declined in subsequent years 5.7% in 2023 and only 1.04% in

Table 3. Number of fresh fruit bunches per palm of Oil Palm hybrids during last five years (2020- 2024)

Hybrids	No. of FFB / palm 2020	No. of FFB / palm 2021	No. of FFB / palm 2022	No. of FFB / palm 2023	No. of FFB / palm 2024	Mean No. of FFB / palm	Cumulative No. of FFB / palm
NRCOP -1	9.20	10.12	11.12	11.15	11.50	10.62	53.09
NRCOP -2	7.40	8.52	9.82	10.10	10.40	9.25	46.24
NRCOP -3	8.00	9.10	10.30	10.50	10.50	9.68	48.40
NRCOP -4	7.80	8.85	9.95	10.00	10.00	9.32	46.60
NRCOP -5	8.70	9.50	10.80	11.10	11.40	10.30	51.50
NRCOP -6	7.80	9.80	10.85	11.20	11.30	10.19	50.95
NRCOP -7	8.00	10.25	10.90	11.40	11.30	10.37	51.85
NRCOP -8	8.00	10.02	10.65	11.20	11.40	10.25	51.27
NRCOP -9	8.80	9.90	10.50	11.30	11.60	10.42	52.10
NRCOP-10	7.90	9.80	10.80	11.25	11.25	10.20	51.00
Mean	8.16	9.59	10.57	10.92	11.07	10.06	50.3
S. Ed	0.06	0.06	0.06	0.0.6	0.06	0.06	0.07
CD (P=0.05)	0.13	0.12	0.13	0.12	0.13	0.12	0.15

* FFB: Fresh Fruit Bunch

Table 4. Fresh fruit bunch (FFB) yield per palm (kg) of oil palm hybrids during last five years (2020- 2024)

Hybrids	FFB yield/ palm (kg) 2020	FFB yield/ palm (kg) 2021	FFB yield/ palm (kg) 2022	FFB yield/ palm (kg) 2023	FFB yield/ palm (kg) 2024	Mean FFB yield/ palm (kg)	Cumulative FFB yield/ palm (kg)
NRCOP -1	115.50	138.84	170.14	181.47	193.20	159.83	799.15
NRCOP -2	112.80	144.16	177.45	186.85	195.52	163.36	816.78
NRCOP -3	119.60	145.78	187.46	192.31	194.25	167.88	839.40
NRCOP -4	111.40	135.85	173.23	179.37	182.50	156.47	782.35
NRCOP -5	115.30	147.25	186.30	192.14	208.05	169.81	849.04
NRCOP -6	101.30	139.65	177.07	187.06	197.75	160.57	802.83
NRCOP -7	102.40	149.45	194.02	205.25	206.23	171.47	857.35
NRCOP -8	98.00	159.32	211.94	224.48	230.85	184.92	924.59
NRCOP -9	138.60	173.25	222.60	246.34	254.04	206.97	1034.83
NRCOP-10	120.10	160.92	219.45	234.00	239.63	194.82	974.10
Mean	113.5	149.45	191.97	202.93	210.2	173.61	868.04
S. Ed	1.65	2.23	1.33	1.21	1.21	1.53	7.63
CD (P=0.05)	3.30	4.46	2.66	2.42	2.42	3.05	15.26

* FFB: Fresh Fruit Bunch

2024, suggesting that the yield potential of oil palm stabilizes at around 15 years after planting. As compared to NRCOP-10 (27.86t/ha and 139.32t/ha) and NRCOP-8 (26.4t/ha & 139.32t/ ha), NRCOP-9 had a higher mean yield and cumulative yield (29.59t and 147.97t/ha). The yields in NRCOP-1 (22.85 t/ha and 114.26 t/ha) and NRCOP-4 (22.31 t/h and 111.85 t) were the lowest recorded. Variation in yield is determined by three traits: the rate at which the inflorescence develops the sex ratio and early inflorescence abortion (18). As a result, the higher yield in NRCOP-9 could be attributed to the new gene combination, which may improve the rate of female inflorescence formation, sex ratio and bunch weight (19).

Mesocarp oil recovery from fresh fruit bunch (Table 6) ranged from 19.50% to 21.90%, with a mean oil recovery of 20.03%. Two hybrids, NRCOP-9 and NRCOP-7, were found to have higher than mean oil recovery (21.9% and 20.4%), whereas the remaining eight hybrids had lower than mean oil recovery. The mean value of the anticipated oil yield was 6.03 t/ha. The range of the oil yield was 5.32t to 7.96t/ha. The mesocarp oil yield of NRCOP-9 was higher than the mean value at 7.96 t/ha, followed by NRCOP-10 at 6.68 t/ha and NRCOP-8 at 6.54 t/ha. NRCOP-4 (5.32t/ha), NRCOP-6 (5.51t/ha), NRCOP-3 (5.53t/ha), NRCOP-1 (5.53t/ha) and NRCOP-2 (5.54t/ha) had the lowest mesocarp oil yield. Ten hybrids, each created from different cross combinations, were examined under similar environmental conditions, with the same dose of nutrients and irrigation water applied to all of the palms. Therefore, the observed variations in oil recovery and yield are primarily attributed to the palms' innate genetic makeup from parental genes. However, the ability of the cross combinations to exert more water and nutrients from the soil, as well as the rate of photosynthesis assimilation of oil, is the most important heritable character observed with 28D and 435P. It also recorded several positive parameters with regard to growth and development of the new hybrid cross combinations (20).

In every hybrid, the kernel was shelled and the yield varied between 1.62 and 2.83 t/ha. NRCOP-9 had the highest kernel production (2.83 t/ha), followed by NRCOP-10 (2.43 t/ha) and NRCOP-8 (2.15 t/ha). NRCOP-4 (1.62t/ha), NRCOP-2 (1.71t/ ha) and NRCOP-3 (1.72t/ha) had the lowest kernel yields. The estimated oil content in their kernels ranged from 38% to 41% across all hybrids (Table 6). According to estimates; NRCOP-9 has the highest oil concentration (41%), followed by NRCOP-1 (41%), NRCOP-7 (41%) and NRCOP-4 (41%). NRCOP-6 and NRCOP-5 were predicted to have lower oil contents (38.00% and 39%, respectively). Kernel oil yield per hectare varied from 663.46 kg to 1161.33 kg/ha with an average of 821.55 kg. The maximum kernel oil production was found in NRCOP-9 (1161.83 kg/ha), whereas the other four hybrids (NRCOP-10, NRCOP-8, NRCOP-5 and NRCOP-1) registered kernel oil yields above the mean value. It may be attributed by additive genes responsible for kernel development and of kernel of synthesis.

Table 5. Fresh fruit bunch yield per hectare (tonnes) of oil palm hybrids during last five years (2020- 2024).

Hybrids	FFB Yield/ha (t) 2020	FFB Yield/ha (t) 2021	FFB Yield/ha (t) 2022	FFB Yield/ha (t) 2023	FFB Yield/ha (t) 2024	Mean FFB Yield/ha (t) (t/ha)	Cumulative FFB Yield/ha (t)
NRCOP-1	16.50	19.85	24.33	25.95	27.63	22.85	114.26
NRCOP-2	16.10	20.61	25.38	26.72	27.96	23.35	116.77
NRCOP-3	17.10	20.85	26.81	27.50	27.78	24.01	120.04
NRCOP-4	15.90	19.43	24.77	25.65	26.10	22.37	111.85
NRCOP-5	16.50	21.06	26.64	27.48	29.75	24.29	121.43
NRCOP-6	14.50	19.97	25.32	26.75	28.28	22.96	114.82
NRCOP-7	14.60	21.37	27.75	29.35	29.50	24.51	122.57
NRCOP-8	14.10	22.78	30.31	32.10	33.01	26.46	132.30
NRCOP-9	19.80	24.78	31.83	35.23	36.33	29.59	147.97
NRCOP-10	17.20	23.01	31.38	33.46	34.27	27.86	139.32
Mean	16.23	21.37	27.45	29.02	30.06	24.83	124.13
S. Ed	0.05	0.31	0.12	0.60	0.61	0.51	1.60
CD (P=0.05)	1.02	0.62	1.24	1.20	1.26	1.04	3.14

* FFB: Fresh Fruit Bunch

Table 6. Oil yield of oil palm hybrids during 2024

Hybrids	Oil recovery / bunch (%)	Oil yield / ha (t)	Kernel yield (t/ha)	Kernel Oil content (%)	Kernel oil yield (kg/ha)
NRCOP-1	20.00	5.53	1.96	41.00	804.31
NRCOP-2	19.80	5.54	1.71	40.00	682.22
NRCOP-3	19.90	5.53	1.72	40.00	688.94
NRCOP-4	20.40	5.32	1.62	41.00	663.46
NRCOP-5	19.50	5.80	2.14	39.00	835.38
NRCOP-6	19.50	5.51	2.04	38.00	773.74
NRCOP-7	20.00	5.90	1.89	41.00	774.08
NRCOP-8	19.80	6.54	2.15	40.00	858.26
NRCOP-9	21.90	7.96	2.83	41.00	1161.83
NRCOP-10	19.50	6.68	2.43	40.00	973.27
Mean	20.03	6.03	2.05	40.1	821.55
S. Ed	0.41	0.20	0.14	0.06	7.53
CD (P=0.05)	0.82	0.42	0.28	0.12	15.45

Conclusion

NRCOP-7 had the largest palm girth of 3.91 meters, while NRCOP-4 had the tallest palm at 5.32 meters. NRCOP-2 produced the maximum number of fronds, while NRCOP-9 had the highest sex ratio (0.78), indicating a greater proportion of female inflorescences, which contributes to higher fruit yield. The main fresh fruit bunch weight was 19.64 kg, while NRCOP1 produced the highest number of fresh fruit bunches of 10.62 per palm (Fig.1). NRCOP-9 recorded the highest cumulative fresh fruit bunch yield (206.94 kg) and the highest yield per hectare (29.59 t/ha). In addition, NRCOP-9 recorded the highest mesocarp oil yield was 7.96 t/ha, with an oil recovery rate of 21.90% (Fig. 2). The hybrid also demonstrated superior kernel oil yield (2.83 t/ha) resulting in a total kernel oil production of 1161.83 kg/ha. Among all hybrids, NRCOP-9 exhibited the highest fresh fruit bunch yield per palm, number of fresh fruit bunches and overall fruit bunch yield, followed by NRCOP-10 and NRCOP-8. These results suggest that NRCOP-9 is a promising hybrid for commercial oil palm cultivation due to its superior yield and oil production characteristics.

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Authors' contributions

VK, AN and MT carried out the field experiment, collected and analyzed the data. VK wrote the manuscript. AN, KK and RAK oversaw the entire study and assisted in the editing and drafting of article. GR and KS conceptualized the study, whereas SS and BAJ executed the methodology. All authors reviewed and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

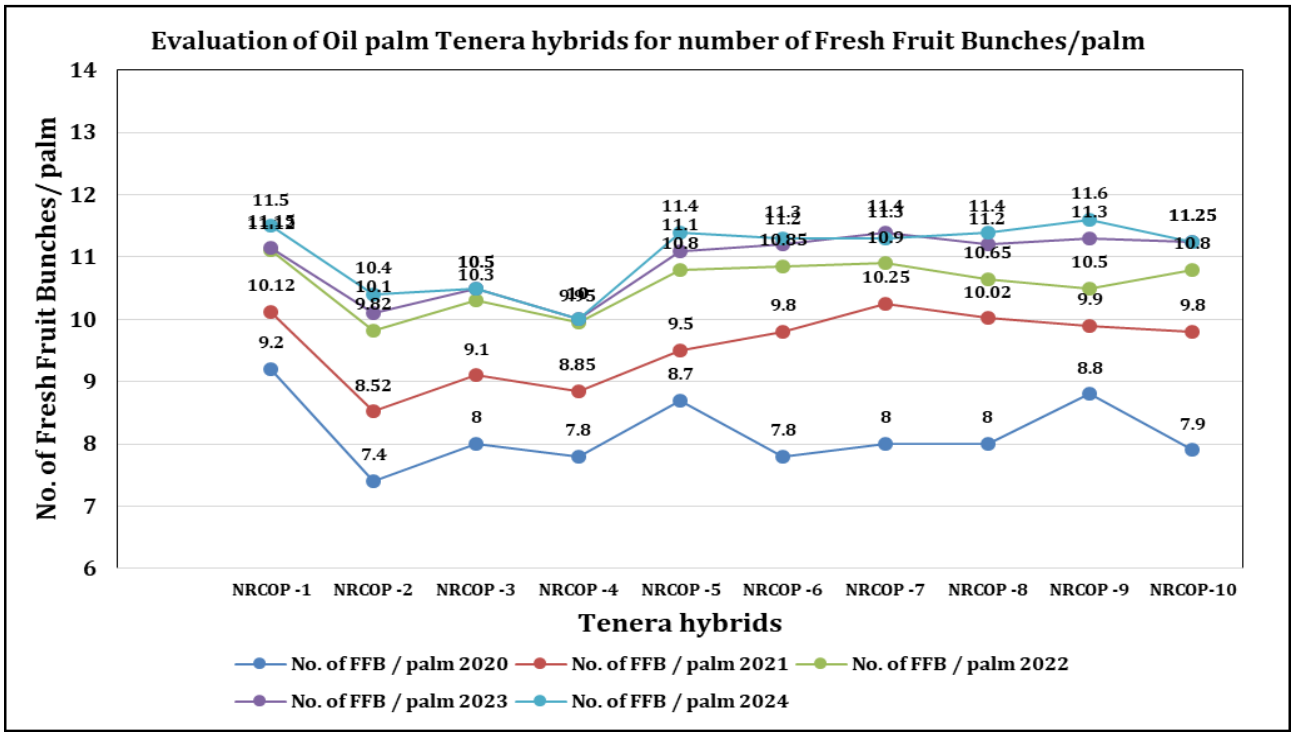

Fig. 1. Evaluation of Oil palm Tenera hybrids for number of Fresh Fruit Bunches/palm

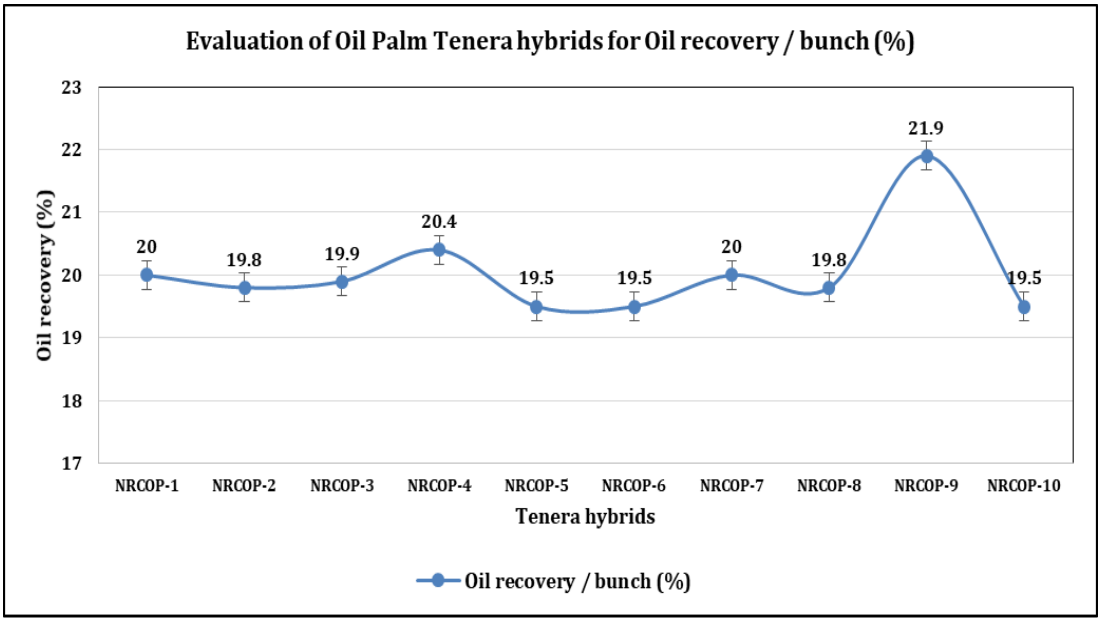

Fig. 2. Evaluation of Oil palm Tenera hybrids for Oil recovery per bunch (%)

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