Research Article

doi:10.25081/jpc.2023.v51.i2.8666
Journal of Plantation Crops, 2023, 51(2): 54-59

Performance of coconut hybrids and varieties in the East coast of Andhra Pradesh

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(Manuscript Received: 25.11.2022, Revised: 24.07.2023, Accepted: 28.07.2023)

Abstract

Coconut (*Cocos nucifera* L.) is one of the plantation crops with more life span, so suitability of a variety or hybrid for particular region may improve the productivity of the coconut. An experiment was carried out with seven hybrids and two varieties *viz*. Chandra Sankara (COD × WCT), Chandra Laksha (LCT x COD), VHC1 (ECT × MGD), VHC-2 (ECT × MYD), Kera Ganga (WCT × GBGD), Laksha Ganga (LCT × GBGD), Godavari Ganga (ECT x GBGD), Kera Chandra (Double Century) and Chandra Kalpa at Dr.YSRHU-Horticultural Research Station, Ambajipeta, Dr. B. R. Ambedkar Konaseema Dist., Andhra Pradesh. The experiment was initiated in 2002, in Randomized Block Design in three replicated blocks. The compiled data for six years (2015- 2021) revealed that, Godavari Ganga recorded significantly highest nut yield /palm/year (144.40 nuts) followed by VHC-2 (134.93 nuts) and Kera Ganga (133.33 nuts). Godavari Ganga recorded maximum copra yield of 3.20 t/ha and oil yield of 2.20 t/ha. Tender nut water quantity was recorded more (322.5 mL) in VHC-2 and Godavari Ganga. Due to its superior nut, copra and oil yield, Godavari Ganga and VHC-2 can be recommended for cultivation Andhra Pradesh.

Keywords: Coconut, Hybrids, Yield, Copra, Cost-economics

Introduction

Coconut (*Cocos nucifera* L.) is an economically important and versatile crop, grown in tropical regions (Nampoothiri and Parthasarathy 2018). One-third of the world's population depends on coconut for food and economic needs (Lalitha 2014). India, the largest coconut producer in the world, accounts for 31% of world production and producing 21,207 million nuts during the year 2020-21 from an area of 2.19 million ha with a mean productivity of 9,687 nuts per hectare (Deepthi and Pramod 2021). Though the productivity of coconut is high in India compared to other countries, it has the potential of 15,000 to 20,000 nuts/ha.. The low productivity is due to the presence of old and senile palms occupying up to one-third of area of cultivation under coconut (Rethinam, 2018). The productivity potential of coconut could be increased considerably by using quality planting material with improved varieties or hybrids. Breeding in perennial crops like coconut is a long term process as traditional plant breeding methods like introduction, selection and hybridization are important basic improvement strategies adopted for the development of improved varieties and hybrids. The coconut varieties and hybrids were evaluated with an aim to utilize the existing variability towards identification of a variety or hybrid suitable for the east coast regions of Andhra Pradesh. Under this study the select genotypes were evaluated for yield potential viz., like number of nuts/palm, number of nuts per ha., copra yield(t/ha.) and oil yield (t/ha.).

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Materials and methods

Coconut hybrids and varieties were evaluated in black soils with obstructed drainage in the coastal region of Andhra Pradesh at Dr.YSRHU-Horticultural Research Station, Ambajipeta under ICAR-AICRP on Palms. The climactic conditions during the experiment period varied with day temperature ranging from 26.3 to 42.5 °C, whereas, night temperatures, average rainfall and relative humidity during the experiment varied from 17.3 to 30.2 °C, 693 to 1230 mm and 45 to 100%, respectively**.**

The experiment was carried out with seven hybrids and two varieties *viz*. Chandra Sankara (COD × WCT), Chandra Laksha (LCT x COD), VHC1 (ECT × MGD), VHC-2 (ECT × MYD), Kera Ganga (WCT × GBGD), Laksha Ganga (LCT × GBGD), Godavari Ganga (ECT X GBGD), Kera Chandra (Double Century) and Chandra Kalpa. The coconut seedlings were planted in the year 2002 at 7.5 × 7.5 m spacing in three replicated blocks in a statistical model of randomized block design with a set of 6 palms/replication. The palms under evaluation were monitored regularly and a standard set of practices was followed as recommended by Dr. YSRHU- HRS, Ambajipeta during the experimental period. The data on vegetative and yield characters were recorded for each palm separately, an average of all the palms in respective replications for the height of the palm up to crown (m), stem girth at 1m height (cm), total number of functional leaves per plam, length of the frond (cm), petiole length (cm) recorded in the year 2021-22 at 20 years were compared in the present study on vegetative characters according to the standard procedure suggested by International Union for the Protection of New Varieties of Plants (UPOV) (Anon 2016). Tender nuts, of six months old, were harvested from the palms and five samples were taken randomly, for estimating the volume of water (mL), minerals potassium and sodium were also estimated using a flame photometer using NaCl and KCl as standards (Tondon, 1993). The average nut yield during July 2015 to June 2022 was studied to document the yield (number of nuts/palm), copra yield, oil yield per palm or nut. Copra yield per palm was calculated by multiplying the average copra content per nut to the number of nuts harvested per palm (6 nuts collected randomly in each harvest for five harvests in a year). Likewise, oil yield per palm was recorded using a Soxhlet apparatus. Data were analyzed for the mean, standard error of deviation, critical difference and co-efficient of variation (Gomez and Gomez 1984). The cost of cultivation was estimated based on the inputs like fertilizers, FYM, pesticides and labour cost (harvesting, fertilizer application and irrigation) and out puts for corresponding years were collected according to the market price and calculated for unit area (hectare) fixed cost, cash flow analysis, economic viability indicators (*viz.,* cost benefit ratio, net returns) of the hybrids were assed as per the procedure explained by Maheswarappa *et al.* (2001) and Sairam *et al.* (1999).p

Table 1. Performance of varieties/Hybrids for growth characters (Age of the palm: 20 years)

Treatments	Height of the palm up to crown(m)	Stem girth at 1m height (cm)	Total number of functional leaves per palm(cm)	Length of 10 internodes (cm)	Total Frond length (cm)	Petiole length
Chandra Sankara	8.70	97.70	32.76	97.21	542.05	131.05
Chandra Laksha	9.18	97.21	33.33	94.22	546.97	128.42
VHC-1	9.26	101.42	33.45	104.11	551.28	130.49
VHC-2	9.49	106.03	33.80	100.16	536.45	128.05
Kera Ganga	8.59	97.05	32.94	94.44	547.08	127.72
Laksha Ganga	8.98	99.57	33.08	94.71	542.44	130.16
Godavari Ganga	8.05	91.23	33.30	78.25	528.44	125.88
Double Century	9.28	112.72	32.54	101.44	566.46	129.16
Chandra Kalpa	9.14	103.50	33.51	101.22	553.07	131.91
S.Em±	0.25	3.51	0.41	4.60	19.33	2.89
CD at 5%	0.75	10.52	NS	13.80	NS	NS

Results and discussion

The varieties and hybrids were evaluated for a period of twenty-one years. The data on growth parameters during 2021 revealed that the height of the palm up to the crown, the girth of the stem at 1m height and the length of 10 internodes varied significantly for the varieties and hybrids under evaluation, total functional leaves per palm, length of the frond and petiole length was recorded non-significant. Godavari Ganga (ECT X GBGD) recorded minimum height of the palm up to the crown (8.05 m) which was on par with Kera Ganga (WCT × GBGD) (8.59 m) and Chandra Sankara (COD × WCT) (8.70 m) as Tall x Dwarf and Dwarf x Tall hybrids will express intermediate height (Nampoothiri and Parthasarathy 2018). Whereas, VHC-2 (ECT x MYD) (9.49 m) recorded the maximum height of the palm up to the crown, whereas, VHC -1 (9.26 m) and Chandra Laksha (9.18 m) recorded height on par with tall varieties like Kera Chandra (Double Century) (9.28 m) and Chandra Kalpa (9.14 m) under evaluation. The results are similar to the findings of (Ramanandam *et al.* 2017), (Sahoo *et al*. 2021) the dwarf parent used for the development of these hybrids might be having robust and vigorous growth. This is in coincidence with the earlier reports on robustness in dwarf varieties of coconut (Rethinam *et al.* 2005). Stem girth at 1m height of the palm was recorded as minimum in Godavari Ganga (91.23 cm) which was on par with Kera Ganga (97.05 cm), Chandra Laksha (97.21 cm) and Chandra Sankara (98.82 cm), stem girth at 1m height was noted more in Kera Chandra (Double Century) (112.72 cm) which was significantly on par with VHC-2 (106.03 cm) and Chandra Kalpa (103.5 cm). The robustness of the hybrid VHC-2 (ECT x MYD) might be due to the inheritance of characters like vigour and robustness from dwarf parent Malayan Yellow Dwarf (Rethinam *et al.* 2005) and climatic factors like soil, temperature and organic content influence the stem girth of coconut (Niral and Jerard 2018). The bole of the hybrids developed using Gauthami Ganga (Ganga Bondam) is intermittent to the talls and dwarfs as the parent has slender trunk (absence of bole).

Godavari Ganga recorded significantly minimum length of 10 internodes (78.25 cm), whereas, maximum length of 10 internodes was noted in VHC-1 (104.45 cm), which was on par with all other hybrids and tall varieties under evaluation. The variation in length of 10 internodes is due to the inheritance of characters from mother palms for total dry matter production. The hybrids express less annual height increment compared to tall as discussed by Naresh Kumar et al. (2008). The total number of functional leaves, the total frond length and petiole length were recorded non-significant among the hybrids and varieties under evaluation.

Yield characters/traits studied for a period of 6 years i.e. 2015-2021 showed that the number of inflorescences produced per palm per year was non-significant among the varieties and hybrids evaluated.

Table 2. Performance of varieties/Hybrids for yield characters average for a period of 6 years

Treatments	Number of inflorescences /palm/year	Number of nuts produced /palm /year	Fruit weight (g)	Oil content (%)	Copra content (g/nut)	Tender nut water(ml)	Sodium content (ppm)	Potassium content (ppm
Chandra Sankara	12.07	124.74	1227.97	60.63	172.89	290.53	25.8	2044.24
Chandra Laksha	11.39	125.50	1180.77	61.85	194.67	315.22	25.13	2193.21
VHC-1	12.02	130.01	918.37	59.91	158.55	251.72	23.2	2305.87
VHC-2	12.53	134.93	1364.73	61.36	204.12	325.22	23.81	2116.32
Kera Ganga	12.04	129.80	1067.80	60.67	186.53	310.52	22.65	2131.5
Laksha Ganga	11.76	123.93	1073.97	58.47	174.38	300.43	23.87	2218.24
Godavari Ganga	12.50	148.63	1255.37	64.52	194.48	325.70	22.81	2109.17
Double Century	11.68	115.41	1474.75	62.42	205.21	308.71	27.18	2354.17
Chandra Kalpa	11.73	114.03	1215.43	64.07	158.22	261.02	26.17	2274.49
S.Em±	0.32	4.17	48.65	0.78	10.27	8.33	1.35	38.55
CD at 5%	NS	11.85	138.35	2.21	29.21	23.61	NS	118.78

Table 3. Performance of hybrids/varieties for yield attributes

Treatments	Nuts/ha	Copra yield t/ha.	oil yield t/ha.
Chandra	18711.43	2.70	1.63
Chandra Laksha	18825.00	3.05	1.89
VHC-1	19501.29	2.58	1.54
VHC-2	20239.50	3.44	2.11
Kera Ganga	19469.79	3.03	1.84
Laksha Ganga	18589.50	2.70	1.58
Godavari	22295.14	3.61	2.33
Double Century	17311.71	2.96	1.85
Chandra Kalpa	17104.29	2.26	1.44
S.Em±	514	0.09	0.08
CD at 5%	1469.13	0.26	0.23

Table 4. Cost economics of coconut hybrids/varieties

Treatments	Gross Returns	Cost of cultivation	Net returns	C:B
Chandra Sankara	189890	73196	116694	2.59
Chandra Laksha	195542	73705	121838	2.65
VHC-1	199112	74026	125086	2.69
VHC-2	202400	74322	128078	2.72
Kera Ganga	199970	74103	125867	2.70
Laksha Ganga	182045	72490	109555	2.51
Godavari Ganga	216600	75600	141000	2.87
Double Century	167007	71137	95871	2.35
Chandra Kalpa	172737	73452	99285	2.35

At 10 Rs./nut

Godavari Ganga (ECT x GBGD) coconut hybrid reported a maximum number of nuts per palm with 148.63 nuts. VHC-2 (134.93 nuts) and VHC -1 (130.01 nuts) were next to Godavari Ganga. Chandra Kalpa (114.03 nuts) recorded a minimum number of nuts per palm. The improved nut yield in hybrids compared to varieties in coconut might be due to hybrid vigour, as in similar findings Rao *et al.* 2002; Jayabose *et al*. 2008; Ramanandam *et al.* 2017. Though the number of functional leaves and total frond length was non-significant among the varieties and hybrids evaluated, there was variation in the length of 10 internodes, so the total dry matter produced might be utilized for nut production in Godavari Ganga (ECT x GBGD) as the minimum length of 10 internodes was observed in this genotype, which could have increased yield over other hybrids.

Matured fruit weight was maximum in Kera Chandra (Double Century)(1474.75 g) on par with VHC-2 (1364.73 g), whereas, in VHC- 1 (ECT x MGD) less fruit weight was recorded (918.37 g). In Kera Chandra (Double Century)(205.6 g/nut) the copra quantity in individual nut was more and was significantly on par with all other varieties and hybrids except Chandra Kalpa, VHC-1 and Chandra Sankara, this might be due to less size of the nuts in these hybrids. The individual nut component traits are influenced by the variety as well as growth conditions (Niral and Jerard 2018) and number of nuts produced per palm have negative impact on individual fruit weight and copra quantity in individual nut (Nampoothiri and Parthasarathy 2018)

Oil content was more in Godavari Ganga 64.52 % significantly on par with Chandra Kalpa 64.02 % and Kera Chandra (Double Century) 62.42 %. Copra yield and oil yield per ha was found to be more in Godavari Ganga (3.61 t/ha. and 2.33 t/ha respectively) which is significantly on par with VHC-2 (3.44 t/ha. and 2.11 t/ha. respectively). The economic characters like copra weight and oil content per palm was more in hybrids, as these characters are influenced by number of nuts per palm directly. This may be due to non-additive gene action exploited in heterosis breeding (Nampoothiri and Parthasarathy 2018). It can justify that hybrids expressed genetic advance and high heritability for higher copra and oil yield per unit area as reported earlier (Ganesamurthy *et al.*2002; Maskromo *et al.* 2013; Niral and Jerard 2018).

The Tender nut water quantity was more in Godavari Ganga (325.70 mL) and was significantly on par with VHC -2 (325.22 mL), Chandra Laksha (315.22 mL) Kera Ganga (310.52 ml) and Kera Chandra (Double Century)(308.71 mL). The variety Chandra Kalpa recorded low tender nut water quantity per nut (158.22 mL). Though sodium content in tender nut water has recorded non-significant maximum sodium content was recorded in Kera Chandra (Double Century)(27.18 ppm) whereas, hybrids recorded a less sodium content. Potassium content was maximum in Kera Chandra (Double Century) with 2354.17 ppm, minimum

was in Chandra Sankara (2044.24 ppm) Chandra Laksha (2193.21 ppm), Godavari Ganga (2109.17 ppm), VHC-2 (2116.32 ppm) and Kera Ganga (2131.5 ppm). The quality parameters like sodium and potassium content in the tender nut water varies with maturity and agro-climatic regions where they were grown similar findings were reported in (Rethinam and Nandakumar 2001) and (Chikkasubbanna *et al.* 2002).

Godavari Ganga produced more nuts 22,295 nuts/ha, high copra yield 3.61 t/ha and oil yield 2.33 t/ha, which was on par with VHC-2 for nuts 20239 nuts/ha, copra yield 3.44 t/ha and oil yield 2.11 t/ha. The copra yield and oil yield are directly proportional to the number of nuts produced in a unit area, as Godavari Ganga and VHC- 2 recorded more nuts per unit area, copra yield and oil yield. The number of nuts produced per unit area is influenced by the climatic conditions, soil conditions and inheritance of yield traits from the parents. The improved yield of coconut hybrids, shows that the hybrids expressed genetic advance, as reported by earlier researchers (Ganesamurthy *et al.*2002), (Niral and Jerard 2018), Godavari Ganga is one of the best yielding coconut hybrid in South India which has good potential to increase the productivity of coconut.

Gross returns and net returns per unit area were observed maximum in Godavari Ganga (Rs. 2,16,600 and Rs. 1,41,000 respectively) and was followed by VHC-2 (Rs. 2,02,400 and Rs. 1,28,078 respectively). The cost benefit ratio was maximum in Godavari Ganga (2.87) and VHC -2 (2.72), all the hybrids under evaluation noted high cost benefit ratio compared to varieties under evaluation. This might be due to more nut yield over the varieties under evaluation. Though the variation in cost benefit ratio shows less difference among the varieties and hybrids under evaluation the difference in the net returns per unit area in maximum and minimum is Rs. 45,128 which will have great impact on the farmer socio-economic status over the years.

Conclusion

The hybrid Godavari Ganga and VHC -2 are significantly superior over the other hybrids and varieties. The Godavari Ganga has a potential to produce more number of nuts 21,600 nuts/ha, copra 3.20 t/ha and oil 2.20 t/ha. Whereas, VHC-2 has potential to produce 20239 nuts/ha, copra 3.07 t/ha and oil 2.08 t/ha, adoption of these hybrids by farmer improve the productivity of coconut which in turn improves the income of the farmer. C:B ratio was found maximum in Godavari Ganga (2.87) which was followed by VHC -2 (2.72). Godavari Ganga is one of the best yielding coconut hybrids in South India which has good potential to increase the productivity of coconut. It can be concluded that Godavari Ganga and VHC-2 can be recommended for cultivation Andhra Pradesh.

Acknowledgements

I hereby acknowledge the various Programme Co-ordinators of ICAR-Central Plantation Crops Research Institute, Kasargod, India who have operated this scheme from 2002 to 2022, for their constant financial and technical support. I take great pleasure to acknowledge the scientist of Dr.YSRHU- Horticultural Research Station, Ambajipeta involved in evaluating this project since 2002.

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