PLANT SCIENCE TODAY
Vol x(x): xx–xx
https://doi.org/10.14719/pst.10198

eISSN 2348-1900

RESEARCH COMMUNICATION

Performance of local coconut (*Cocos nucifera* L.) germplasm under Assam conditions of the North East region of India

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Received: 23 June 2025; Accepted: 16 October 2025; Available online: Version 1.0: 22 December 2025

Cite this article: Singh LS, Niral V, Acharya GC, Chaithra M, Alpana D, Jyoti R. Performance of local coconut (*Cocos nucifera* L.) germplasm under Assam conditions of the North East region of India. Plant Science Today (Early Access). https:/doi.org/10.14719/pst.10198

Abstract

The study was carried out to elucidate the performance of local coconut accessions collected from different parts of Assam in the North East region of India, an experiment was conducted at the Research Centre, ICAR-Central Plantation Crops Research Institute. Observations were recorded on growth, yield, fruit and nut characters and tender nut water and quality of 13 local coconut accessions. The experiment was laid out in 3 replications, with 4 palms per replication. The study showed that accession, KKHC 4 produced the highest nut yield and kernel content, indicating its potential suitability for cultivation in the North East region. Accession KKHC 6 exhibited enhanced fruit size and a higher volume and quality of tender nut water, suggesting its value for both fresh consumption and beverage markets. These findings highlight the necessity for region specific coconut improvement programs and underscore the importance of selecting and promoting locally adapted germplasm.

Keywords: accession; coconut; growth; tender nut; yield

Introduction

Coconut (*Cocos nucifera* L.) or 'Tree of Heaven' is an important plantation crop grown in India. Globally, India ranks first in coconut production and productivity and third in terms of area under cultivation, contributing significantly to country's agricultural economy. Traditionally, 4 southern states namely Kerala, Karnataka, Tamil Nadu and Andhra Pradesh contribute more than 90 % of the area and production of coconut in the country (1). In India, coconut is cultivated in an area of 2275000 ha with the annual production of 20535 million nuts and productivity of 9018 nuts per ha (2). Recent developments indicate a noteworthy expansion into north eastern regions, particularly Assam. Coconut cultivation has been spreading to non-traditional areas particularly North East region. Assam, Tripura, Nagaland are the major states having coconut cultivation, together covering an area of 26480 ha and a total annual production of 175.88 million nuts (2). Other North Eastern states like Manipur, Mizoram, Meghalaya and Arunachal Pradesh are also having small extent of coconut cultivation. Among the various North Eastern region, Assam is blessed with 6 agro ecological zone, namely North Bank Plain (Darrang, Udalguri, Sonitpur, Lakhimpur, Dhemaji), Upper Brahmaputra Valley (Dibrugarh, Jorhat, Sivasagar, Tinsukia) Central Brahmaputra Valley (Morigaon, Nagaon), Lower Brahmaputra Valley (Barpeta, Bongaigaon, Chirang, Dhubri, Goalpara, Kamrup, Kokrajhar, Nalbari, South Salmara), Barak Valley (Silchar, Cachar, Hailakandi, Karimganj) and Hill Zone (Dima Hasao, Karbi Anglong) favours the growth of a wide range of plantation crops. Among the various plantation crops grown in Assam, coconut is one of the important crop grown mostly by small and marginal farmers. Area under coconut in Assam is estimated to be 21580 hectares, with an average production of 156.92 million nuts and productivity of 7272 nuts per hectare (2). Though coconut is grown in most of the districts of Assam, its cultivation is mainly confined to Central and Lower Brahmaputra Valley Zone of Assam. Nagaon district has the largest area under coconut (2490 ha) followed by Barpeta (1636 ha), Nalbari (1390 ha) and Kamrup Rural (1200 ha) (2). The crop has gained substantial importance among the farming community since they can sell the tender or ripe nuts at monthly interval whenever they face financial problem (3) and the demand for both tender and mature nut is increasing in the state realizing the nutritional and health benefit. Towards developing improved varieties for specific agro-climatic zones, it is necessary to characterize and evaluate the coconut genetic resources to identify their yield potential and other traits specific for utilization in the coconut improvement programme. Characterization of coconut populations/ cultivars/germplasm has been undertaken based on fruit traits (4, 5), botanical and agronomic traits (6).

Research on crop improvement is ongoing in southern India,

where coconut is grown commercially. However, in North East region of India, limited work has been conducted to study the suitability of coconut varieties in this region. Therefore, the present investigation was undertaken to study the performance of thirteen local coconut accessions for growth, nut yield and fruit and nut characteristics and tender nut quality to enhance the coconut germplasm suitable for Assam of North East region of India.

Materials and Methods

Study was conducted for ten years from 2014 to 2023 at ICAR-Central Plantation Crops Research Institute, Research Centre, Kahikuchi, Guwahati, Assam, situated at 26° 10' N latitude and 91° 60' E longitude with an altitude of 50 m above the mean sea level (MSL). The mean maximum temperature varies from 15 to 32°C and the mean minimum temperature ranges between 8 and 22 °C. The climate is sub-tropical with an annual rainfall of about 1500 mm. The soil of the experimental site was alluvial clay loam, with a pH range of 4.8 to 5.5. Organic carbon as well as available N, P and K content varied from 0.98 to 1.37 % and 194.0 to 249.5, 21.9 to 43.8, 173.6 to 268.8 kg ha^{-1}, respectively at surface soil (7). The study involved thirteen local coconut genotypes, planted during May 2004 at a spacing of 7.5 x 7.5 m. The experiment was laid out in Randomized Blocks Design (RBD) with 3 replications. Four palms per replication were taken for observations. Vegetative growth parameters namely palm height, stem circumference (measured at the height of 1.0 m from ground level), number of leaves, number of leaf scars per meter (measured at the height of 1 to 2 m from ground level), length of leaf stalk, number of leaflet, length and breadth of leaflet and leaflets bearing portion were recorded. Regarding fruit and nut characters, fruit weight, fruit length, fruit circumference, nut weight (husked fruit weight), nut length (husked fruit length), nut circumference (husked fruit circumference), husk thickness, shell thickness, shell weight, endosperm (fresh kernel) thickness and endosperm weight were also recorded. The fruit length and nut length (husked fruit length) were measured at the polar zone, while the fruit circumference and nut circumference (husked nut circumference) were measured at the equatorial zone of the fruit. The annual nut yield per palm was recorded during each harvest and used to compute the annual nut yield (number of nuts per palm per year). Biochemical parameters like TSS were recorded with Erma hand refractometer and pH of the coconut water was determined with digital pH Meter 335. Minerals like potassium and sodium were estimated using a flame photometer (8) and for estimation of titratable acidity, the samples were titrated against 0.01 N NaOH using phenolphthalein as an indicator. The titer was recorded and the titratable acidity was expressed as a percentage of malic acid. Data were analyzed using one way analysis of variance (ANOVA) to study the effect of treatments. Post-hoc comparisons were carried out using Tukey's Honest Significant Difference (HSD) test and statistical significance was considered at $p < 0.05$. All the statistical analysis were done using SPSS version 26.

Results and Discussion

Vegetative growth characters

The data on growth parameters revealed that palm height up to the crown, number of leaves, number of leaf scar/metre, number of leaflets and length and breadth of leaflet varied significantly for the accession under evaluation (Table 1). Maximum palm height was observed in KKHC 1 accession (4.74 m) and the minimum palm height was observed in KKHC 13 (3.27 m). With regards to number of leaves and breadth of leaflets, KKHC 4 accessions was found to produce a greater number of leaves and breadth of leaflets. Trunk circumference among the accessions varied from 84.88 cm to 93.67 cm, but were found to be non-significant among the accessions. Maximum number of leaf scar per meter was observed in KKHC 13 (24.33). The observed variability in growth characters among coconut accession might be attributed to intrinsic genetic difference, complex inheritance patterns and interaction with the environment. Variability in growth characters among different coconut germplasm were also reported (9-11).

Average yield of thirteen local coconut accessions has been presented in Fig. 1. Average mean yield among the accessions varied from 10.40 to 49.54. A higher average mean yield was observed in the accessions KKHC 4 (49.54) followed by KKHC 6 (40.86). Higher number of functional leaves in this accession may lead to production of more number of fruit. The importance of more number of leaves as an important trait in increasing yield of coconut has been reported since it increases the photosynthetic efficiency of the palm (11). Variation in fruit yield among different coconut genotypes was also reported in the Coconut Research Station, Aliyarnagar, Tamil Nadu (12).

Quality traits of tender nut

Quality analysis of tender nut of local coconut germplasm is presented in Table 2. The maximum tender nut weight (2688.46 g), volume of water (548.73 mL) and potassium content (2445.33 ppm)

Table 1. Growth performance of local coconut accession

Accessions	Palm height (m)	No. of leaves	Trunk circumference (cm)	No. of leaf scars/ m	Length of leaf stalk (cm)	Length of leaflet Bearing portion (m)	No. of leaflets (left)	No. of leaflets (right)	Length of leaflets (cm)	Breadth of leaflets (cm)
KKHC 1	4.79	21.91	92.61	15.61	1.25	3.10	94.11	95.36	98.72	4.14
KKHC 2	4.31	18.67	91.11	16.58	1.04	2.56	87.39	88.36	92.97	3.62
KKHC 3	4.09	20.33	93.67	14.33	1.02	2.97	92.66	92.25	98.30	4.37
KKHC 4	4.55	26.47	86.14	15.08	1.22	2.94	95.75	95.94	103.05	4.56
KKHC 5	4.46	22.83	89.19	16.50	1.02	3.00	93.42	94.42	95.97	4.47
KKHC 6	4.37	21.08	87.55	17.52	1.13	3.12	94.11	95.44	105.44	3.95
KKHC 7	4.05	17.39	85.25	18.11	0.97	2.98	102.30	103.22	104.03	4.56
KKHC 8	4.46	15.78	87.14	17.28	1.16	2.98	96.50	97.44	98.19	3.68
KKHC 9	4.59	18.83	93.47	17.28	0.83	2.94	97.15	98.00	103.92	4.30
KKHC 10	4.49	17.55	88.22	17.78	0.99	2.90	92.17	93.33	99.72	4.06
KKHC 11	4.60	17.62	92.11	17.97	1.16	3.21	95.05	96.30	98.50	3.80
KKHC 12	3.34	15.14	86.25	21.53	0.93	3.06	94.11	94.77	94.33	3.86
KKHC 13	3.28	14.44	84.88	24.33	0.88	2.51	88.33	90.00	95.22	4.18
SEm (+/-)	0.24	1.53	3.91	1.05	0.15	0.14	2.13	2.01	2.30	0.17
CD	0.69	4.45	NS	3.06	NS	NS	6.22	5.88	6.73	0.48
CV	9.63	2.18	7.61	10.28	24.34	8.15	3.92	3.67	4.03	2.18

Table 2. Quality traits of tender nut water of local coconut accessions

Accessions	Weight of fruit (g)	Volume of water (mL)	TSS (°Brix)	Titratable acidity	pH	Sodium (ppm)	Potassium (ppm)
KKHC 1	1512.03	355.04	4.93	0.07	4.92	28.02	1299.20
KKHC 2	1835.72	451.43	5.20	0.09	5.05	25.46	1386.30
KKHC 3	2122.98	492.92	6.70	0.08	5.86	21.17	1312.85
KKHC 4	1602.56	409.86	5.37	0.11	5.12	22.23	1167.10
KKHC 5	1530.36	503.02	4.13	0.07	4.93	15.02	1352.25
KKHC 6	2688.46	568.73	6.17	0.07	5.27	40.22	2445.32
KKHC 7	1631.31	378.62	6.53	0.09	5.07	31.16	1719.39
KKHC 8	1727.54	401.33	6.10	0.09	5.13	27.24	1466.67
KKHC 9	1657.95	385.50	6.97	0.09	4.88	23.02	1594.17
KKHC 10	1565.41	369.13	5.58	0.08	4.93	19.17	1518.37
KKHC 11	1381.37	215.31	7.20	0.06	5.34	42.79	1530.32
KKHC 12	1173.40	255.12	4.37	0.06	5.01	20.03	1342.57
KKHC 13	1706.99	348.63	5.10	0.08	4.85	24.22	1552.03
SEm (+/-)	12.90	18.37	0.44	0.002	0.13	1.44	9.89
CD	37.65	53.62	1.29	0.005	0.37	4.19	28.85
CV	1.31	8.09	13.40	4.06	4.27	9.52	1.13

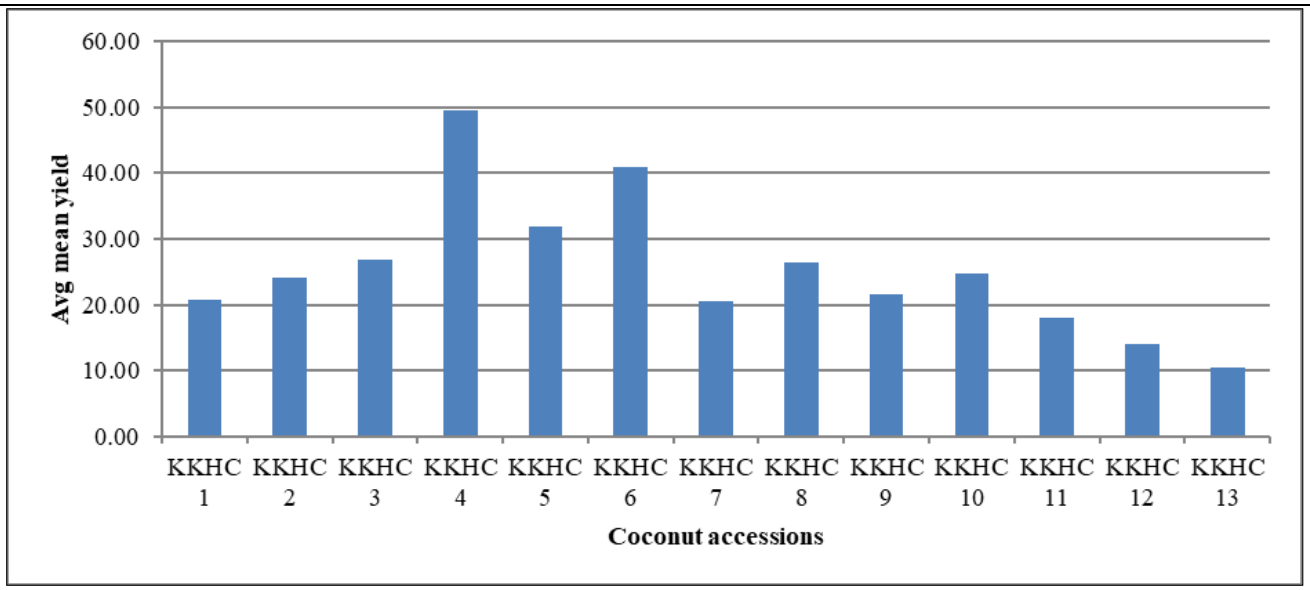

Fig. 1. Average mean yield of local coconut accessions.

harvested at 6th month was observed in KKHC 6 accession. While TSS and sodium content was comparatively higher in KKHC 11. The accessions show significant differences for the quality traits studied. Tender nut water volume in the present study varied from 215. 31 mL to 568.73 mL. The proportion of tender nut water content among cultivars and at varying maturity stages has also been reported, with the maximum volume of tender nut water observed at the 6th month. It has been further noted that the quality of tender nut varies with variety, agro-climatic conditions and horticultural practices (13-16).

Fruit and nut characters

Fruit component traits of local coconut accession have been presented in Fig. 2. Variation in fruit weights, shell, kernel and water percentage were observed among the accessions with accession KKHC 6 recording the highest fruit weight (1200 g). Husk weight was found to be higher in all the accession studied as compared to other traits, which ranges from 38 to 46 % KKHC 12 accession, was found to produce higher husk weight (46 %). KKHC 3 and KKHC 7 accessions recorded a lower husk weight percentage of 38 %. Kernel weight was the second heaviest component among the fruit trait studied. Kernel content among the accession varied from 22 to 31 %. Accessions KKHC 8 and 12 recorded the lowest kernel content. With regards to shell and water weights, KKHC 1, KKHC 2, KKHC 11, KKHC 12 accessions showed more or less equal percentages varying from 16-17 % and 11-15 % for shell and water respectively. Genetic variability in fruit size, husked fruit weight, husk thickness, endosperm thickness and endosperm weight among coconut genotypes has also been reported (17, 18). Higher water content above 15 % was observed in KKHC 3, KKHC 4, KKHC 6, KKHC 8 and KKHC 9 accessions.

Based on husk weight and kernel weight, a few coconut cultivars with the potential to contribute higher per-nut kernel content in coconut breeding programs were identified (19). This study also reported a high diversity for fruit components characters and the need for more extensive analysis.

Conclusion

Coconut (*Cocos nucifera* L.) is a crucial plantation crop in India, particularly for sustaining the livelihoods of small and marginal farmers in Assam and North East states. Despite its socio-economic importance, systematic efforts to enhance coconut productivity in this region remain inadequate. The present study aimed to evaluate 13 indigenous coconut genotypes under the agro-climatic conditions of Assam. The evaluation focused on growth, tender nut water, nut yield and fruit morphological traits. Significant genotypic variability was observed, particularly in parameters related to nut yield and fruit characteristics. Among the evaluated accessions, KKHC 4 demonstrated higher performance in terms of nut yield and kernel content and KKHC 6 for larger fruit size with greater volume and superior quality of tender nut water indicating its potential suitability

Fig. 2. Percentage of each fruit component in different local coconut accessions. Weight of total fruit are given in the middle of the circle. **A.** KKHC 1, **B.** KKHC 2, **C.** KKHC 3, **D.** KKHC 4, **E.** KKHC 5, **F.** KKHC 6, **G.** KKHC 7, **H.** KKHC 8, **I.** KKHC 9, **J.** KKHC **10**, **K.** KKHC11, **L.** KKHC12, **M.** KKHC13.

for cultivation in the North East. These findings highlight the necessity for region specific coconut improvement programs and underscore the importance of selecting and promoting locally adapted germplasm. The outcomes of this study can provide a scientific basis for guiding cultivar selection, extension interventions and policy formulation aimed at improving coconut productivity and profitability in the North East states.

Acknowledgements

The authors thank the Director, ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala, India, for providing the facilities and support to conduct this research work.

Authors' contributions

VN and GCA helped in the collection of germplasm from different parts of Assam and helped in the modification and coordination. MC and AD helped acquire data and collect samples. LSS performed the data compilation, sequence alignment and drafted the manuscripts. JR helped with the statistical analysis. All the authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: The authors report there are no competing interests to declare.

Ethical issues: None

Declaration of generative AI and AI-assisted technologies in the writing process: While preparing this work, the author used ChatGPT to improve language and grammatical mistakes.

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Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

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