



Morphological characterization and performance of different pineapple (*Ananas comosus*) varieties in northern parts of West Bengal

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ABSTRACT

Pineapple [*Ananas comosus* (L.) Merr.] is popular all over the world for its pleasant aroma, sweet-acidic taste and smooth pulp texture. It is the third most important fruit on the basis of global trade after banana and citrus. The present investigation was carried out in 2014–16 to assess the growth behaviour and performance of different pineapple varieties like Kew, Queen, Mauritius, Haricharanvita, Baruipur Local, MD-2, MTS, and Amritha in northern parts of West Bengal. The experiment was laid in Randomized Block Design (RBD) for successive two years. The indigenous Haricharanvita variety showed the maximum vigour in terms of plant height, leaf length and canopy spread. The maximum numbers of leaves were recorded in Kew followed by Queen. Maximum leaf area was also recorded in Kew and the maximum numbers of suckers were produced by Mauritius followed by Baruipur Local. Mauritius exhibited earliest (325.75 days) and maximum flowering (98.34%), required lowest time (109.45 days) for maturity compared to all varieties assessed. Indigenous Haricharanvita and Baruipur Local exhibited delayed and lesser flowering percentage with longest fruit maturity time. Highest yield (without crown) was recorded in Kew (89.70 t/ha), followed by Mauritius (57.54 t/ha), while it was lowest in Baruipur Local (31.00 t/ha). Among the physico-chemical parameters, Mauritius recorded highest pulp percentage (62.70%), TSS (18.10°brix), total sugar (12.87%), ascorbic acid (45.52 mg/100g) content, TSS: acid ratio (28.14) and lowest peel (17.82%) and crown (17.79%) content. Among the different varieties studied, Mauritius was found to be the best table purpose variety under northern part of West Bengal.

Keywords: Growth, Performance, Pineapple, Suckers, Variety

Pineapple is an important tropical fruit, globally preferred for aroma, and the special blend of sweet and acidic taste of its soft pulp. *Ananas*, the original name of pineapple, comes from the word ‘Tupi’ (Rio de Janeiro, Brazil), and *comosus* means ‘tufted’ (Herbst 2001, Annon 2015). Due to the presence of crown at the top pineapple is also called as ‘King of Fruits’ as well as ‘Golden Queen’ in some areas. It is a xerophytic, succulent, tropical, herbaceous, perennial monocot plant which bears flowers on a terminal inflorescence which gets converted into a large, edible fruit (Annon 2008). India has a considerable share of global pineapple production and West Bengal is the leading pineapple producer in India followed by Assam and Tripura. Kew, a late maturing variety under Cayenne pineapple group particularly valued for its canning quality, is intensively cultivated in Darjeeling (Siliguri sub-division), Jalpaiguri, Uttar Dinajpur and Cooch Behar districts in

West Bengal. Queen and Mauritius are popular table varieties for good pulp quality. Recently, MD-2 is being preferred worldwide for its multiple disease resistance, taste, quality, sweetness and yellow pulp. Monoculture of Kew variety as well low soil pH coupled with faulty cultural, nutrient management practices often lead to more chances of disease and pest infestation and production of uneven fruit with high nitrate content which hinders the processing as well as export. Choice of cultivating different varieties instead of only ‘Kew’ can alleviate the problem. However, performance of different pineapple varieties is not known due to the non-availability of research work on this aspect under northern climatic condition of West Bengal. Keeping this in view, the present study was carried out to assess the comparative performance of commercial ‘Kew’ and other pineapple varieties for growth behaviour, yield and quality in northern part of West Bengal.

MATERIALS AND METHODS

This experiment was conducted at the Instructional Farm, Department of Pomology and Post-Harvest Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal (26°19'86" N latitude and 89°23'53" E longitude, altitude 43 m amsl). The land was medium high in situation with good drainage facility. The soil is coarse

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textured sandy loam with poor water holding capacity. The climatic condition of this zone is characterized by high rainfall and humidity, moderate temperature, prolonged winter with high residual soil moisture. The investigation was carried out considering the eight pineapple varieties as different treatments in Randomized Block Design (RBD) for successive two years (2014–15 and 2015–16) to study their growth habit, flowering and fruiting characteristics.

The varieties selected were Kew (late-maturing commercial variety of West Bengal), Queen (most preferred table purpose variety of homestead garden in North-eastern states including West Bengal), Mauritius (most suited table purpose variety and has best quality, high keeping quality, transportability under Queen group), Haricharanvita (indigenous to northern parts of West Bengal, vigorous, having long, slender, leaves with heavily serrated leaf margins), Baruipur Local (indigenous to southern parts of West Bengal, moderately vigorous with profusely serrated leaf margins), MD-2 (world leading pineapple variety, originated from Hawaii and preferred for its colour, flavour, shape, lifespan and ripeness), MTS (developed by Kerala Agricultural University, Kerala) and Amritha (hybrid between 'Kew' and 'Ripley Queen' from Kerala Agricultural University (Annon 2017).

Healthy, disease free, homogenous (300–400 g) planting materials (suckers) were selected, processed and treated with fungicides and planted during the month of February, 2014 and 2015 separately in double row system (plant to plant distance 25 cm, distance between two rows 35 cm and distance between two beds 90 cm) in 3 beds each consisting of 25 plants with inter bed guard rows. Standard dose of manures and fertilizers were applied following proper application schedule.

Different growth parameters like plant height, number of leaves, character of D-leaf (length, breadth, area), suckering habit were recorded as suggested by Ubi *et al.* (2016). Parameters on flowering-fruiting behaviour like days taken to 50% flowering, flowering percentage, maturity period etc. were studied as well as fruit yield was estimated with and without crown. Fruit physico-chemical properties were recorded following the standard procedure (Ranganna 1977, AOAC 1984). The statistical analysis was followed by mean separation for different parameters which was performed using Least Significant Difference (LSD) test ($P \leq 0.05$). Normality of residuals under the assumption of ANOVA was tested using Kolmogorov-Smirnov, Shapiro-Wilk, Cramer-Von Mises and Anderson Darling procedure using Proc-Univariate procedure of SAS (version 9.3).

RESULTS AND DISCUSSION

Comparison of phenological studies and flowering, fruiting characteristics of different pineapple varieties are discussed below with the pooled means of two years data (2014–15 and 2015–16).

Phenological parameters of pineapple varieties: The local Haricharanvita variety showed the maximum vigour in terms of plant height (102.64 cm) at 18 months after planting,

followed by Kew (99.48 cm) while the most dwarf cultivar was Amritha (69.41 cm) which was statistically at par with MTS (72.30 cm) and MD-2 (78.76 cm). Maximum height of Haricharanvita might be due to genetic nature as well as local origin of this geographical condition. Normally, the height of Kew (vigorous smooth Cayenne group) is more than the Queen and Mauritius cultivars (Queen group), which is evident from the result of the present experiment. Similar result was observed by Joy and Anjana (2016) who reported that the growth characters of Mauritius and MD-2 were similar in plant height while Amritha was shorter. The plant height of different pineapple varieties was reported to vary between 48 and 110 cm which is similar with the result of present experiment (Rosmania *et al.* 2019, Neri *et al.* 2021). Lowest number of leaves were recorded in Amritha (43.60) which was statistically at par with MTS (44.60) and MD-2 (50.32), whereas, the maximum numbers of leaves were recorded in Kew (70.27) which was statistically at par with Queen. Joy and Anjana (2016) reported that the number of leaves progressively increased from 20 at 3 months to 34 at 12 months. Leaf number of cv. Queen varied between 36–61.90 (Rosmania *et al.* 2019). Analysis of D-leaf was used to estimate growth and plant nutritional status. Present study indicated significant variation of D-leaf characters among the pineapple varieties. Haricharanvita has maximum D-leaf length (77.46 cm) while it is lowest in MTS (55.49 cm) closely followed by Amritha (57.29 cm). The D-leaf length of Haricharanvita was higher probably due to its vigorous nature and could be considered as a desirable varietal selection trait (Prakash *et al.* 2009). Significant difference of D-leaf length was also observed by Laishram *et al.* (2012) and Neri *et al.* (2021). Leaf breadth was recorded maximum with Kew (5.27 cm) followed by Queen (5.21 cm), Baruipur Local (5.08 cm), MD-2 (5.04 cm). Leaf area was recorded maximum with Kew (388.12 cm²), which was statistically at par with Queen (361.36 cm²), Baruipur Local (357.14 cm²) followed by MD-2 (307.27 cm²), Mauritius (306.20 cm²), Haricharanvita (295.40 cm²), MTS (260.08 cm²) and lowest in Amritha (218.34 cm²). The local cultivar Haricharanvita expressed the maximum canopy volume (1076.47 litre) and lowest canopy volume was recorded in Amritha (259.49 litre). Haricharanvita produced the maximum numbers of slips (2.44) followed by Queen (2.09) and least by MD-2 (1.22) as well as Amritha (1.22). On the other hand, the maximum numbers of suckers were produced by Mauritius (2.77) followed by Baruipur Local (2.52) and least by Amritha (1.40). Chan and Lee (1995) reported that Queen strain Tailung produced excessive suckers (about 6/plant). Cabral *et al.* (2005) reported higher number of suckers and few slips in the Cayenne cultivar. These results are in conformity with the present experiment. Flowering and fruiting habit of different pineapple varieties are presented in Table 1. Among the different varieties assessed, Mauritius required lowest duration to provide 50% flowering (325.75 days) followed by Kew (339.52 days) while Haricharanvita (371.32 days) and Baruipur Local (365.57 days) showed maximum duration

Table 1 Performance of different pineapple varieties with respect to morphological, flowering-fruitlet characters and yield

Variety	Plant height (cm)	Leaf (nos.)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm ²)	Canopy volume (litre)	Slips (nos.)	Sucker (nos.)	Days for 50% flowering	Flowering (%)	Maturity (days)	Eye (nos.)	Yield with out crown (t/ha)
Kew	99.48ab	70.27a	73.35ab	5.27a	388.12a	812.35b	1.48cd	1.56c	339.52e	91.11b	129.90c	115.80a	89.70a
Queen	90.35bc	66.84 ab	69.42b	5.21a	361.36a	645.12c	2.09b	2.19b	351.29c	88.89b	120.77e	107.48b	54.96b
Mauritius	82.92bc	55.97cd	63.85c	4.80bc	306.20b	521.04d	1.81bc	2.77a	325.75f	98.34a	109.45f	99.28c	57.54b
Haricharanvita	102.64a	60.18 bc	77.46a	3.82b	295.40bc	1076.47a	2.44a	2.38b	371.32a	78.34c	143.97a	101.45c	39.82c
Baruipur Local	91.36b	51.54 de	70.37b	5.08ab	357.14a	787.63b	1.64c	2.52ab	365.57b	75.56c	136.27b	88.23e	31.00d
MD-2	78.76cd	50.32 def	60.93cd	5.04ab	307.27b	460.84e	1.22d	1.47c	340.15e	77.23c	122.15de	94.45d	36.45cd
MTS	72.30cd	44.60ef	55.49e	4.68c	260.08c	305.51f	1.27d	1.60c	342.44d	77.23c	125.67cd	85.25ef	34.53cd
Amritha	69.41d	43.60 f	57.29de	3.82d	218.34d	259.49g	1.22d	1.40c	342.85d	76.12c	126.58cd	84.53f	33.74cd
SEm±	3.46	2.33	1.50	0.12	12.57	10.61	0.12	0.12	0.27	1.28	1.48	0.99	2.28
LSD at 5%	10.50	7.07	4.56	0.36	38.18	32.49	0.35	0.36	0.82	3.88	4.50	3.00	6.90

**Means with the same letter are not significantly different.

for achieving 50% flowering, respectively. The performance of Mauritius variety regarding the flowering percentage was excellent (98.34%, significantly highest) followed by Kew (91.11%) and Queen (88.89%) which is highly desirable. The lowest flowering was observed in Baruipur Local (75.56%) followed by Amritha (76.12%), MTS (77.23%), MD-2 (77.23%) and Haricharanvita (78.34%). Prakash *et al.* (2009) also reported higher flowering percentage in PQM-1 compared to other cultivars. In the present study, Mauritius required lowest time for maturity (109.45 days) followed by Queen (120.77 days) and MD-2 (122.15 days). Haricharanvita, the local cultivar of North Bengal, required longest time to mature (143.97 days) followed by Baruipur Local (136.27 days), this might be due to vigorous nature of the plant. Late maturity can offer an additional option to fruit growers, consumers and canning industry to get fresh fruit over a longer period (Prakash *et al.* 2009). Similar finding was also reported by Joy and Anjana (2016) regarding flowering, fruit maturity, suckering and slip formation of Amritha and Mauritius varieties. The numbers of eyes were recorded highest in Kew (115.80) followed by Queen (107.48) and the lowest in Amritha (84.53) which were statistically at par with MTS (85.25). Similar result was reported in PQM-1 (84.6) by Prakash *et al.* (2009). The estimated yield without crown was recorded highest in Kew (89.70 t/ha), followed by Mauritius (57.54 t/ha) and Queen (54.96t/ha) and observed lowest in Baruipur Local (31.00 t/ha), followed by Amritha (33.74 t/ha), MTS (34.53 t/ha) and MD-2 (36.45 t/ha). Joy and Anjana (2016) also observed maximum yield of 34.07 t/ha in Mauritius followed by MD-2 (30.83 t/ha), whereas, Amritha produced least yield (26.98 t/ha). Yield of Sensuous pineapple varied between 59–100 t/ha (Valleser 2018). It was found that Moris Taiwan was about 15% higher yielding than the other Queen genotypes (Chan and Lee 1995). These reports are in line with the present experiment.

Fruit physico-chemical properties of pineapple varieties: Fruit length was maximum (22.36 cm) in Kew, closely followed by Queen (19.58 cm), and Mauritius (18.57 cm). Baruipur Local recorded the maximum crown length (33.99cm), followed by Haricharanvita (30.07 cm) and Kew (27.27 cm). The lowest crown length was observed with Mauritius (19.10 cm) which was statistically at par with MD-2 (20.43 cm), MTS (19.71 cm) and Amritha (19.80 cm). Fruit length with crown was maximum for Kew (49.62 cm) which was statistically at par with Baruipur Local (49.10 cm). The fruit length with crown was lowest in Amritha (33.99 cm) followed by MTS (34.40 cm) and MD-2 (36.10 cm) (Table 2). The smaller crown size is an important desirable characteristic for marketing, processing as well as for better fruit quality. Fruit circumference was maximum in Baruipur Local (40.28 cm) followed by Queen (39.42 cm), Kew (37.01 cm) and lowest in Amritha (20.79 cm). It is evident that variety Kew possessed significantly maximum fruit weight (1877.10 g). Higher fruit weight was also observed in Queen (1196.56 g), Mauritius (1109.45 g) and Haricharanvita (1101.45 g). Amritha yielded the smallest

Table 2 Physico-chemical parameters of different pineapple varieties

Variety	Fruit length (cm)	Crown length (cm)	Fruit + Crown (cm)	Fruit circumference (cm)	Fruit weight (g)	Crown weight (g)	Pulp (%)	Peel (%)	Crown (%)	TSS (°brix)	Total sugar (%)	Ascorbic acid (mg/100g)	TSS: Acidity
Kew	22.36a	27.27bc	49.62a	37.01ab	1877.10a	1098.67a	58.54b	21.64d	17.98d	15.29b	11.97b	37.65bc	22.58b
Queen	19.58b	24.70c	44.28b	39.42a	1196.56b	704.66b	58.89b	20.11e	19.23c	18.00a	12.38b	39.80b	27.13a
Mauritius	18.57b	19.10d	37.67c	32.13bc	1109.45b	695.99b	62.70a	17.82f	17.79d	18.10a	12.87a	45.52a	28.14a
Haricharanvita	15.32c	30.07b	45.40b	28.79cd	1101.45b	495.51c	44.99e	25.17b	27.86a	13.54d	9.61e	33.04cd	17.91d
Baruipur Local	15.11cd	33.99a	49.10a	40.28a	884.18c	384.25d	43.46f	26.92a	27.47a	12.21e	9.03f	32.04d	15.70e
MD-2	15.67c	20.43d	36.10cd	24.65de	926.16c	517.06c	55.83c	21.88d	20.41b	14.82c	10.63c	34.40cd	20.90c
MTS	14.69cd	19.71d	34.40d	23.14e	879.80c	476.49c	54.17d	23.36c	20.62b	14.11c	9.99de	32.92cd	18.99d
Amritha	14.19d	19.80d	33.99d	20.79e	871.39c	475.63c	54.58d	23.03c	20.50b	13.93d	10.12d	34.63bcd	19.05d
SEm±	0.36	0.96	1.01	1.79	46.63	25.85	0.19	0.14	0.24	0.24	0.13	1.74	0.40
LSD at 5%	1.08	2.92	3.08	5.42	141.43	78.41	0.56	0.41	0.85	0.71	0.41	5.28	1.20

**Means with the same letter are not significantly different.

fruit (871.39 g) followed by MTS (879.80 g) and Baruipur Local (884.18 g). The pooled mean value indicates that Amritha yielded smallest crown (178.64 g) and it was statistically at par with MTS (181.40 g), MD-2 (189.02 g), and Mauritius (196.56 g). On the other hand, bigger fruited Kew had largest crown (337.64 g) followed by Haricharanvita (307.03 g) and Baruipur Local (242.94 g) which may be due to the genetical character. Larger fruit and crown were also reported by Laishram *et al.* (2012) and Lu *et al.* (2014) in Kew and Giant Kew, while lower fruit weight in Queen was reported by Chan and Lee (1995). Joy and Anjana (2016) reported that the Mauritius and MD-2 varieties had almost similar fruit weight while Amritha had smaller fruits. Kew also exhibited the maximum weight (1539.46 g) without crown, followed by Queen (966.47 g) and Mauritius (912.88 g).

Mauritius showed the maximum pulp content (62.70%), followed by Queen (58.89%) and Kew (58.54%) and it was minimum in indigenous Haricharanvita (44.99%) and Baruipur Local (43.46%). Lowest peel (17.82%) and crown (17.79%) content was recorded with Mauritius followed by Queen (20.11%) and Kew (17.98%), respectively. Haricharanvita and Baruipur Local exhibited higher crown (27.86% and 27.47%), peel (25.17%, 26.92%) and lower pulp (44.99%, 43.46%) content compared to all other studied varieties which indicated their inferiority. MD-2 had least pulp content (57%). These observations were in agreement with Joy and Anjana (2016) who reported that the Amritha and Mauritius had higher pulp (62% and 61% respectively) mainly due to the smaller crown. Higher total soluble solids (above 12°brix) with low titratable acidity (0.4–0.6%) are considered better for consumable quality of pineapple fruits (Ercisli 2007, George *et al.* 2016). In this present experiment, Mauritius showed maximum TSS (18.10°brix) followed by Queen (18.00°brix) and minimum TSS was recorded with indigenous Haricharanvita (13.54°brix) and Baruipur Local (12.21°brix). Significantly maximum total sugar was recorded in Mauritius (12.87%) followed by Queen (12.37%) and Kew (11.97%). Lower total sugar content was observed in indigenous Baruipur Local (9.03%) and Haricharanvita (9.61%). Chan and Lee (1995) reported that Queen strain Tailung had high sugar content (15.5%) and very good eating quality which confirms the finding of the present study. Mauritius recorded the highest ascorbic acid (45.52 mg/100g) content followed by Queen (39.80 mg/100g) and Kew (37.65 mg/100g), whereas, it was least in Baruipur Local (32.04 mg/100g) followed by MTS (32.92 mg/100g) and Haricharanvita (33.04 mg/100g). Lu *et al.* (2014) reported ascorbic acid range of 33.57 mg/100 g in MD-2 to 5.08 mg/100 g in Smooth Cayenne. Similar finding was also reported by Ramsaroop and Saulo (2007). The maximum TSS:Acidity ratio was recorded in Mauritius (28.14) followed by Queen (27.13) and Kew (22.58), whereas, the lowest value was recorded in Baruipur Local (15.70) followed by Haricharanvita (17.91). Lu *et al.* (2014) reported that the TSS:Acidity ratio is the most reliable parameter index for

evaluating pineapple fruit quality and it ranges from 17.15 in Smooth Cayenne to 41.08 in Ripley.

The performance of different pineapple varieties was evaluated and local pineapple var. Haricharanvita exhibited highest plant height and canopy spread. Highest flowering percentage was noticed in Mauritius variety and it was lowest in Baruipur Local. The days required for flowering was minimum in Mauritius which indicates its early maturity. Though the estimated yield was recorded highest in Kew variety, followed by Mauritius, the superiority of Mauritius over other varieties was assessed in this study for high flowering percentage, low maturity period and excellent pulp quality, higher TSS, total sugar content, ascorbic acid content, TSS:Acidity ratio including low crown percentage. Mauritius pineapple performed best under northern part of West Bengal and can be recommended for further commercial cultivation particularly for table purpose.

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