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Evaluation of the fruit characteristics of some accession of palmyrah palm grown in Bhagalpur district of Bihar

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Abstract
Borassus flabellifer L. belongs to family Arecaceae and commonly known as Palmyrah palm. It has great economic potential and every part of the palm is useful in one way or the other. The fruits, fruit sap, young tuberous seedlings of palmyrah palm are used as food and leaves, trunk, roots are used for making different non edible products. It is easily grown without much care and can be spotted growing in wild, in agricultural fields and sporadically even on wastelands as stray plantation. Few published data is available on the fruit characteristics of Palmyrah palm. The result of this research may be used to develop an index for the breeding programmes in future.

Keywords: Palmyrah palm, accession, fruit character

Introduction
Borassus flabellifer L belongs to family Arecaceae and commonly known as Palmyrah palm. It is a native of tropical Africa but cultivated and grown throughout India (Nesbitt, 2005) [4]. It is a vigorous and robust tree and can live more than 100 years. It can reach a height of 30 metres (98 ft), with a canopy of green-bluish leaves. India ranks first in the world in terms of its wealth of palmyrah palm with a population nearly 122 million palms (Vengaiah *et al.* 2012) [6]. Borassus is the genus of six species of fan palm and its fruits can be eaten either roasted or raw. The plants are dioecious having male and female flowers on separate plants. Pollination occurs by both wind and insect. The flowers are small, in densely clustered spikes, followed by abundant, brown, roundish fruits. Fruits are large, fibrous and measures 4 to 7 in diameter. Leaves are used for making baskets, umbrellas, hats, thatching etc. and base of the leaf stalk used for straining the toddy.

Material and Methods
Fifteen accessions of Palmyrah palm of different morphological characteristics were collected from different locations of Bhagalpur region of Bihar during the year 2016-2017. The fruits were harvested at maturity stage and transported through corrugated fibre boxes with paddy straw and paper and brought to the laboratory. The morphological characters measured were fruit length, fruit width, the weight of the fruit, the weight of the pulp, weight of the peel, weight of the seed, pulp %, peel % etc. All the parameters were recorded in three replicates. As soon as fruits arrived in the laboratory, they were sorted out to remove damaged ones and then the fruits were washed, weighted, peeled and pulped. The pulp, the seed and the peelings were weighed using an electronic balance (Precisa, France).

Results and Discussion
Morphological characteristics among all the fifteen accessions of Palmyrah palm were observed in Table 1, Table 2, Table 3 and Table 4. The result (Table 1) showed that the average fruit weight of Palmyrah palm was 1327.77 g while the fruit weight of palmyrah palm ranged from 1192 g to1480 g in AC-12 and AC-1 respectively. The variation in fruit weight among the genotypes was also reported by different workers Vengaiah *et al.* (2015) [7]. The diameter of fruit ranged from 15.14 cm to 18.31cm with the average of 16.61 cm. The highest fruit diameter was observed in AC-13 which was significantly at par with AC-11. The result (Table 2) showed minimum weight of seed (406.70 g) was noted in AC-10, which was statistically at par with AC-3 (413g) and AC-12 (423.30g). The highest seed weight (533.00 g) was produced by AC-15 followed by AC-14 (526.70 g), AC-1 (510 g), AC-4 (503.37 g) which is significantly at par with each other.

There is a very limited report on the variation of seed weight of palmyrah palm which is a varietal character. The variation in weight of seed in different genotypes is due to variation in fruit weight which is a governed genetically as palmyrah palm is a cross-pollinated crop where natural hybridization is rampant. In other fruit crops like mango the different attributes of seed like seed percentage, their length, seed thickness, the width of seeds varied among the variety as reported by workers like Teaotia and Shrivastava, (1961) [5], Badyal and Bhutani (1989) [2] and Dutta *et al*. (2008) [3]. The pulp weight (Table 3) of Palmyrah palm varied considerably from 590 g in AC-1 followed by AC-5, AC-3 while as the minimum pulp weight was recorded in AC-12 (420 g) with an average weight of 499.32 g. Pulp percentage ranged from 34.16% to 41.12%, and the average percentage of pulp is 37.54. The results are by the outcome of Ali *et al*. (2010) [1] working with wild populations of *Adansonia digitata* L. (baobab) in Malawi. The result (Table 4) showed highest weight of peel (170 g) was observed in AC-1 and minimum in AC-9 (115 g). This might be due to the variation in the weight of fruit and peel thickness of a genotype. The maximum peel thickness was noticed in AC-6 (2.55 mm) and minimum peel thickness (2.31 mm) was obtained in AC-7.

Table 1: Variability in fruit characteristics among different accessions of Palmyrah palm fruits

Treatments	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)
AC-1	1480.00^{a}	16.08^{fghi}	16.40^{def}
AC-2	1285.00^{cde}	15.57^{ghi}	15.14^{g}
AC-3	1296.70^{cde}	17.52^{abcd}	16.45^{def}
AC-4	1325.83^{bcd}	16.77^{cdef}	16.75^{bcde}
AC-5	1435.19^{ab}	17.68^{ab}	17.21^{bcd}
AC-6	1392.49^{abc}	17.94^{a}	16.90^{bcde}
AC-7	1308.12^{cd}	15.18^{i}	15.87^{fg}
AC-8	1294.00^{cde}	17.67^{abc}	16.30^{ef}
AC-9	1226.70^{de}	16.75^{def}	16.50^{def}
AC-10	1216.47^{de}	16.80^{bcdef}	16.24^{ef}
AC-11	1391.00^{abc}	17.41^{abcde}	17.60^{ab}
AC-12	1192.00^{e}	16.46^{fg}	15.30^{g}
AC-13	1305.00^{cde}	16.20^{fgh}	18.31^{a}
AC-14	1386.00^{abc}	15.51^{hi}	17.51^{abc}
AC-15	1382.07^{abc}	16.55^{ef}	16.66^{cdef}

Value indicates mean of three replicates. Different letters in the same columnl indicate significant differences at $P \leq 0.05$ (Duncan' Multiple Range Test).

Table 2: Variability in cup and seed characteristics among different accessions of Palmyrah palm fruits

Treat-ments	Cup (Calyx) weight (g)	Cup (Calyx) %	Seed weight (g)	Seed (%)
AC-1	82.00^{abcd}	5.54^{bcd}	510.00^{ab}	34.46^{defg}
AC-2	77.00^{bcde}	5.99^{abcd}	423.30^{def}	32.94^{gh}
AC-3	79.00^{bcd}	6.08^{abcd}	413.30^{ef}	31.87^{h}
AC-4	86.00^{ab}	6.51^{ab}	503.37^{abc}	37.97^{ab}
AC-5	81.00^{abcd}	5.66^{abcd}	460.00^{bcdef}	32.05^{h}
AC-6	93.00^{a}	6.69^{ab}	499.97^{abc}	35.90^{bcde}
AC-7	88.00^{ab}	6.76^{a}	486.70^{abcd}	37.21^{abc}
AC-8	65.00^{e}	5.03^{d}	459.97^{bcdef}	35.55^{cdef}
AC-9	82.00^{abcd}	6.67^{ab}	440.00^{cdef}	35.87^{bcde}
AC-10	79.00^{bcd}	6.52^{ab}	406.70^{f}	33.43^{fgh}
AC-11	83.00^{abc}	5.98^{abcd}	473.37^{abcdef}	34.03^{efgh}
AC-12	81.00^{abcd}	6.78^{a}	423.30^{def}	35.51^{cdef}
AC-13	69.00^{de}	5.30^{cd}	476.67^{abcde}	36.53^{abcd}
AC-14	89.00^{ab}	6.44^{abc}	526.70^{ab}	38.00^{ab}
AC-15	72.00^{cde}	5.25^{d}	533.00^{a}	38.43^{a}

Value indicates mean of three replicates. Different letters in the same columnl indicate significant differences at $P \leq 0.05$ (Duncan' Multiple Range Test).

Table 3: Variability in pulp and fibre characteristics among different accessions of Palmyrah palm fruit

Treat-ments	Pulp weight (g)	Pulp (%)	Pulp : Seed ratio	Fibre weight (g)	Fibre (%)
AC-1	590.00^{a}	39.84^{ab}	1.16^{c}	128.00^{cde}	8.65^{d}
AC-2	526.70^{bcd}	40.98^{a}	1.24^{ab}	137.00^{cde}	10.66^{bcd}
AC-3	533.30^{abc}	41.12^{a}	1.29^{a}	116.10^{e}	8.95^{d}
AC-4	453.37^{ef}	34.16^{g}	0.90^{f}	165.10^{ab}	12.45^{ab}
AC-5	580.00^{ab}	40.39^{a}	1.26^{ab}	191.19^{a}	13.32^{a}
AC-6	529.97^{bcd}	38.03^{bcd}	1.06^{d}	120.55^{de}	8.66^{d}
AC-7	450.00^{ef}	34.36^{fg}	0.92^{ef}	164.42^{ab}	12.57^{ab}
AC-8	459.97^{ef}	35.50^{efg}	1.00^{de}	155.07^{bc}	11.98^{ab}
AC-9	460.00^{ef}	37.49^{cde}	1.05^{d}	129.70^{cde}	10.57^{bcd}
AC-10	466.70^{ef}	38.32^{bc}	1.15^{c}	141.07^{bcde}	11.60^{abc}
AC-11	563.37^{ab}	40.47^{a}	1.19^{bc}	131.27^{cde}	9.44^{cd}
AC-12	420.00^{g}	35.23^{fg}	0.99^{de}	128.70^{cde}	10.80^{bcd}
AC-13	473.37^{def}	36.23^{def}	0.99^{de}	138.97^{bcde}	10.65^{bcd}
AC-14	496.40^{cde}	35.78^{efg}	0.94^{ef}	124.90^{de}	9.01^{d}
AC-15	486.70^{cde}	35.32^{fg}	0.91^{ef}	145.37^{bcd}	10.52^{bcd}

Value indicates mean of three replicates. Different letters in the same columnl indicate significant differences at $P \leq 0.05$ (Duncan' Multiple Range Test).

Table 4: Variability in peel characteristics among different accessions of Palmyrah palm fruit

Treat-ments	Peel weight (g)	Peel thickness (mm)	Peel (%)	Edible : Non- edible ratio
AC-1	170.00^{a}	2.38^{defg}	11.49^{ab}	0.87^{cde}
AC-2	121.00^{gh}	2.42^{cdef}	9.42^{ef}	0.97^{ab}
AC-3	155.00^{b}	2.52^{ab}	11.96^{a}	0.94^{b}
AC-4	118.00^{gh}	2.37^{efg}	8.92^{fg}	0.73^{f}
AC-5	123.00^{g}	2.47^{bc}	8.57^{g}	1.00^{a}
AC-6	149.00^{bcd}	2.55^{a}	10.72^{cd}	0.82^{e}
AC-7	119.00^{agh}	2.31^{g}	9.10^{fg}	0.74^{f}
AC-8	154.00^{bc}	2.35^{fg}	11.93^{a}	0.75^{f}
AC-9	115.00^{h}	2.48^{bc}	9.39^{ef}	0.83 ^{de}
AC-10	123.00^{g}	2.48^{bc}	10.12^{de}	0.88 ^{cd}
AC-11	140.00^{ef}	2.41^{cdef}	10.08^{de}	0.92^{bc}
AC-12	139.00^{f}	2.46^{bc}	11.68^{a}	0.75 ^{f}
AC-13	147.00^{cde}	2.38^{defg}	11.29^{abc}	0.76 ^{f}
AC-14	149.00^{bcd}	2.45^{cd}	10.75^{bcd}	0.73 ^{f}
AC-15	145.00^{def}	2.43^{cde}	10.50^{d}	0.73 ^{f}

Value indicates mean of three replicates. Different letters in the same columnl indicate significant differences at $P \leq 0.05$ (Duncan' Multiple Range Test).

Conclusion

By results and discussion made so far, it may be concluded that the AC-1 were found best regarding fruit weight, pulp weight, the weight of peel etc. The findings can be used to develop an index for the selection of best accession in breeding programmes in the future.

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