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# Physical Characterization of Fruits and Seeds of Palmyrah (*Borassus flabellifer)* (Arecaceae)

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**Abstract:** Palmyrah is categorized under palm tree category like coconut tree and it has huge variety of uses. Thereby it is considered as "tree of life" and serve as a source for group of people in Island. Variations among fruits, seeds and physical characteristics of these components play their main role in better selection of tree for crop improvement programs. It was observed the variation in fresh fruit weight, fresh pulp weight, number of seeds present inside the fruit, fresh and dried seed weight and pulp yield. Highest frit weight was observed as 3404 g and lowest was 930 g whereas seed variation was observed by bi, tri and tetra seeded. Maximum fruit pulp yield was gained as 65 % and lowest was 17 % whereas average was 28 % for the samples were taken. At the same highest significant correlation coefficient was observed among fresh seed weight (FSW) and dried seed weight (DSW) (r=0.895; p=0.01) and between fresh fruit weight (FFW) and fresh pulp weight (FPW) (r=0.770; p=0.01) and these significances was tested by using Pearson's correlation coefficients (r) test from SPSS statistical software. Variations among the physical characteristics of fruit and seed give more possibilities for selection for crop improvement studies in future.

**Key words:** Crop Improvement · Palmyrah Tree · Physical Characters · Variations

## INTRODUCTION

The palmyrah palm is a dioecious plant and commonly known as Multipurpose tree. It possesses a great capacity to yield several products of economic importance and hence it is called "Wishing tree" which means a palm that yields anything and everything [1]. There are varieties of palmyrah products available in the local and international market [2]. Palmyrah is used for the welfare of the people; it serves as food (fruit, sap, young shoots) as a building material (the stem, the leaves). It is also used in the pharmacopoeia (roots, male inflorescence) and the leaves are used to make a variety of objects, brooms, baskets, fences and roofs [3]. Fruits mature during August and ripen fruits fall from palm during September and October and it can be considered as a potential source of raw material for the development of industrial viable products through value addition [4]. Ripped fruit pulp used in different food preparations at domestic level [5]. Fresh palmyrah pulp could be extracted manually or mechanically from raw palmyrah fruit [6].

The large variability is being existed in this tropical tree species in respect to morphological and physical characteristics of fruits and seeds. The studies on variability are important to aid in the characterization of families or species of the same genus plants, identification and certification of plant material used in propagation of plant [7].

However, given the great diversity of tree species there are few studies evaluating the physical characteristics of the fruits and seeds for species of the family Arecaceae. An improved understanding about tropical tree species is a requirement for their use in commercial plantation and agroforestry systems [8]. Therefore, the objective of this study was to determine the main physical characteristics of fruits and seeds of Palmyrah (*Borassus flabellifer*) and to establish the correlations estimates among the characteristics.

Based on the potential of the palmyrah, biometry studies and its interrelations become necessary for characterization of this species' fruits and seeds, since it may contribute to the determination of plants patterns in

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genetic improvement programs, besides providing knowledge for direct and indirect selection [8]. Considering the potential of palmyrah associated to the lack of knowledge about its physical characteristics, it is justified the need for basic research on the fruits and seeds biometry.

## MATERIALS AND METHODS

**Sample Collection Method:** The mature fruits were collected from 10 different locations as 10 fruits per location (one fruit sample from one tree) from Mannar town Divisional secretariat division.

The fruits (100 numbers) were randomly collected in polyethylene bags with tags for different trees from different locations and taken to palmyrah research institute located in Kaithady, Jaffna, where the study was carried out immediately. In the laboratory, the fruits were previously selected, discarding those visually impaired or deformed and a sample of 100 fruits was taken for measurement of physical characteristics.

**Measurements on Physical Characters:** After measuring the size and recording the different shape of fruits, the fruit fresh mass (FFM) was determined after the manual squishing of pulp using big size spoon without adding water to avoid the mass added by water. The removal of seeds was performed after manual peeling and then, through counting, the number of seeds per fruit was determined.

The measurements on fruit, seed and pulp mass, in grams, were obtained by individual weighing in a digital balance with 7 kg capacity and 1 g accuracy. Pulp mass was calculated as direct weight and percentage of the fruit mass. Observation also has been done on the shape of fruit by visual interpretation.

After the biometric characterization of the fruits, the seeds were manually extracted and then it was determined the longitudinal and transverse seed diameter, the fresh and dry mass using digital balance with 7 kg capacity and 1 g accuracy. The physical characterization of the fruits and seeds were analyzed by frequency distribution.

**Statistical Analysis:** The biometric data of the fruits and seeds were analyzed using the adjustment of statistical distributions and descriptive statistics, who understood the measurements of position (average, minimum and maximum values) and dispersion. Correlation coefficients were estimated at the level of 5% probability for the association between the biometric characteristics of fruits and seeds. All analyses were performed using excel spreadsheet and SPSS software.

## RESULTS AND DISCUSSION

Some of the results of descriptive statistical analysis for the physical characteristics of the fruits and seeds of *Borassus flabellifer* ("palmyrah") are shown in Table 1.

The skewness values were close to zero (i.e., lower than 1.0) for fruit weight, number of seeds, fresh seed weight and dried seed weight (Table 1). These findings indicate an approximately normal distribution for these variables.

The ripped fruits data showed that 90% of them were 3 seeded fruits with weight ranging from 1012 g to 3404 g and a mean weight of 1756 g of the remaining 8% were two seeded fruits from 930 g to 1381 g and 2% were four seeded fruits with minimum and maximum values 2228 g to 2852 g respectively. Among the fruit samples maximum weight of 3404g was observed with three seeded fruit.

Once the fruits are measured they were squeezed to separate the pulp, which is present inside the pericarp, by means of physical force without adding water. Then squeezed pulp was undergone to measurement and the minimum weight was 234 g and the maximum weight was 1461 g. The pulp yield was calculated using pulp weight and fruit weight. The maximum value for pulp yield was gained as 65% and minimum value was 17% with an average of 28%.

The separated seeds were used to take two kinds of measurements of fresh seed weight and dry seed weight individually and calculated the mean seed weight for single fruit separately and from this data it is observed the minimum fresh seed weight of 171 g and maximum fresh seed weight of 458 g. After the measurement on fresh weight of seed they were allowed to dry under the shade to avoid the reduction in germination ability and dried weight of seeds were measured. It was observed the minimum dried seed weight of 110 g and maximum weight of 364 g after the four weeks interval.

The values of the coefficients of variation ranging from 22.52 % to 36.84 % for fruits and 10.20 % to 24.02 % for palmyrah seeds (Table, 1). Coefficients of variation for Fruit Weight, Pulp Weight, Fresh Seed Weight, Dried seed weight and Fruit Pulp Yield indicated that the data observed in these variables have a more heterogeneous

Table 1: Physical characteristics of the fruits and seeds of palmyrah

| Characteristics | Mean | Minimum | Maximum | Skewness | CV (%) |
|---|---|---|---|---|---|
| Fruit Weight | 1733.130 ± 474.31 | 930 | 3404 | .710 | 27.35 |
| Pulp Weight | 494.05 ± 182.64 | 234 | 1461 | 1.759 | 36.84 |
| Number of Seeds | 2.940 ± 0.3 | 2.0 | 4.0 | -1.439 | 10.20 |
| Fresh Seed Weight | 288.07± 69.17 | 171 | 458 | .589 | 24.02 |
| Dried seed weight | 208.87 ± 44.37 | 110 | 364 | .971 | 21.15 |
| Fruit Pulp Yield (%) | 28.50 ± 6.42 | 17 | 65 | 1.841 | 22.52 |

Data refer to mean values (n = 100) ± standard deviation. CV: coefficient of variation.


Fig. 1: Different morphological shapes of palmyrah fruits

distribution (highly dispersed) whose values of the coefficients of variation were greater than 15% (Table 1). These results suggest that for maximum efficiency in industrial processing, the variability in fresh weight require proper selection of matrices plants and/or classification by mass after the harvest of palmyrah fruits. The fruits of higher fresh mass should be preferred for manufacturing, because they have higher percentage of pulp mass and therefore higher yield in processing.

Fruits of palmyrah were observed with different shapes of round, oblong and oval (Figure 1).

Morphological characterization of fruits can provide information on the handling and processing of the palmyrah fruits and more advanced stage of commercial and industrial exploitation, assisting in the design of machinery and equipment [7].

With respect to the frequency distribution for the fresh fruit mass (FFM), it can be verified that 90% of the fruits had values in three weight classes – i.e., from 1001 to 2500 g. For the fresh seed mass nearly 50% of seed had the mass within the range of 221 to 320 g and for the dried seed mass approximately 90% of seed had the mass within the range of 151 to 250 g (Figure 2 c and d).

Fruit pulp yield ranging from 15 to 65%, with approximately 90% of the fruits presenting values in two pulp yield classes between 15 to 35% (Figure 2 b).

In addition to the study of the measurement of physical characteristics of fruits and seeds, it is also necessary to evaluate the association between these characteristics [9]. Association between the characteristics is important because it allows to verify the degree of interference of a characteristic in another characteristic of economic interest, as well as to practice the indirect selection.

In this context, the Pearson's rank correlation coefficient is used to express the degree of association between two numerical characteristics. A positive or negative Pearson correlation coefficient corresponds, respectively, to an increasing or decreasing monotonic trend between two variables.

The values obtained for the Pearson's correlation coefficient of the physical characteristics of the fruits and seeds of *B.flabellifer* (Table 2) indicated that there was a positive and significant association between fresh fruit weight with fresh pulp weight, number of seeds, fresh seed weight and dried seed weight. Fresh pulp weight correlated significantly with number of seeds, fresh seed weight, dried seed weight and fruit pulp yield, whereas fresh seed weight correlated significantly with dried seed weight.

The highest values of the Pearson's correlation coefficients (r) were observed between the fresh seed weight (FSW) and dried seed weight (DSW) (r=0.895; p=0.01) (Table 2) between fresh fruit weight (FFW) and fresh pulp weight (FPW) (r=0.770; p=0.01) (Table 2). Based on this result, it is possible to identify and select *B.flabellifer* fruits with higher pulp weight by other physical characteristic such as fresh fruit weight (FFW).

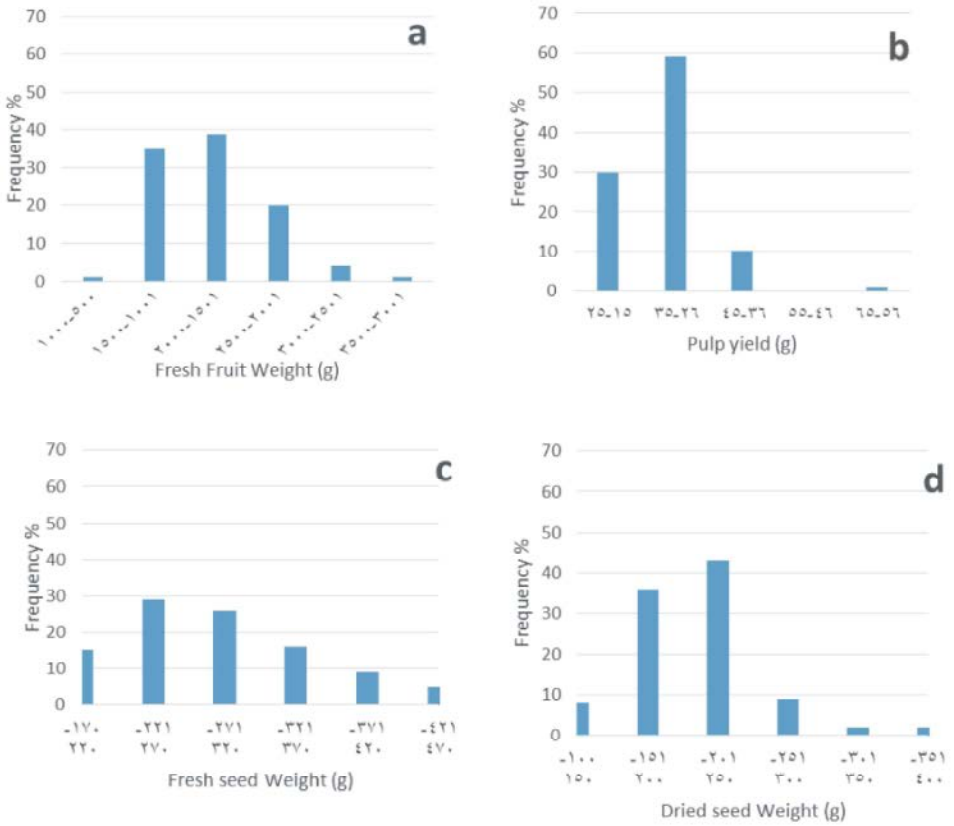


Fig. 2: Distribution of frequencies for the different physical characteristics of the fruits and seeds measured. a) Fresh fruit mass, b) Pulp yield, c) Fresh seed mass, d) Dried seed mass of palmyrah fruit.

Table 2: Pearson rank correlation coefficient (r) between different physical characteristics of the fruits and seeds of Palmyrah (*Borassus flabellifer*).

| | FFW | FPW | NOS | FSW | DSW |
|---|---|---|---|---|---|
| FPW | 0.770** | | | | |
| NOS | 0.359** | 0.224* | | | |
| FSW | 0.777** | 0.593** | 0.058$^{NS}$ | | |
| DSW | 0.753** | 0.644** | 0.023$^{NS}$ | 0.895** | |
| FPY | 0.005$^{NS}$ | 0.611** | -0.059$^{NS}$ | -0.009$^{NS}$ | 0.069$^{NS}$ |

$^{NS}$: not significant. *: $P = 0.05$. **: $P = 0.01$. FFW: Fresh fruit weight, FPW: Fresh pulp weight. NOS: Number of seeds, FSW: Fresh seed weight, DSW: Dried seed weight, FPY: Fresh pulp yield.

Therefore, the selection of plants with fruits of greater fresh mass favors the breeding programs of the species, since, the selection of plants that have fruits with higher values of this characteristic, resulted in the increase of pulp weight.

On the other hand there was negative correlation between fruit pulp yield with number of seeds and fresh seed weight. The increase in the values of these physical characteristics are is undesirable for the economic exploitation of the *B.flabellifer* fruits, since the pulp is one part of the fruit which is consumed. In this sense, the improvement of this characteristic need to be prioritized in breeding programs.

The knowledge of the degree of association between two variables allows defining the interference of the selection performed in one characteristic in another [9]. Thus, according to the results obtained in this study, it is possible to verify that some physical characteristics of the fruits and seeds evaluated in the *B.flabellifer* presented a high correlation, being possible to practice direct and indirect selection for these characteristics.

## CONCLUSIONS

The *Borassus flabellifer* (palmyrah) presents variation in fruit weight, pulp weight, pulp yield and seed

mass, which can be explored for breeding programs in order to improve the crop.

The high fruit pulp weight can be improved with the assortment of fruits of superior fresh mass due to the high degree of link between these features.

## REFERENCES


1. Tharmaratnam, G., P. Navaratnam and S. Srivijeindran, 2018. Preservation of Palmyrah hastorium, young fruit kernel and boiled tuber with lengthen shelf-life consisting their native characters Preservation of Palmyrah Haustorium, Young Fruit Kernel and Boiled Tuber with Lengthen Shelf-Life Consisting their Native Characters, (July).
2. Prod, J.N., P. Resour, K. Velauthamurty, S. Mary, G. Sashikesh and S. Srivijeindran, 2015. Enhance the quality of palmyrah (*Borrasus flabellifer* ) jaggery, Journal of Natural Product and Plant Resources, 5(2): 37-42.
3. Vijaya kumara, B.V.P. and K.R.M.G. Prasad, 2015. 'Physico-Chemical Properties of Palmyrah fruit Pulp (*Borassus flabellifer* L).', Journal of Nutrition & Food Sciences, 05(05). doi: 10.4172/2155-9600.1000391.
4. Wickramasinghe, I., 2018. Process optimization of pectinase enzyme in Palmyrah fruit pulp for clarification Process optimization of pectinase enzyme in Palmyrah fruit pulp for clarification, (October), pp: 31-35.
5. Mahilrajan, S., S. Balakumar, V. Arasaratnam, T. Kumanan and R. Kailayalingam, 2017. Glycemic Index and Insulin Index of Palmyrah Based Edible Products Commonly Consumed in Jaffna', IOSR Journal of Biotechnology and Biochemistry, 03(01): pp: 37-42. doi: 10.9790/264x-0301013742.
6. Mahendran, S., K. Balasubramaniam and K. Sivaganeshan, 1993. Mechanical extraction of palmyrah fruit pulp. Bioprocess Engineering, 8(5): 301-302.
7. Steiner, F., A.M. Zuffo and T. Zoz, 2017. 'Physical characterization of fruits and seeds of jambolan [*Syzygium cumini* (L.) Skeels] (Myrtaceae)', pp: 79-90.
8. Gusmão, E., F.A. Vieira and É.M. fonseca-júnior, 2006. Biometricade frutose endocarpos demurici (*Byrsonima verbascifolia* Rich. ex A. Juss.). Cerne, 12(1): 84-91.
9. Zuffo, A.M., G.S. Gesteira, J.M. Zuffo-júnior, F.R. Andrade, I.O. Soares, E.V. Zambiazzi, S.R. Guilherme and A.S. Santos, 2016. Caracterização biométricade frutose sementes demirindiba (*Buchenavia tomentosa* Eichler) edeinajá (Attalea maripa [Aubl.] Mart.) naregiãosul doPiauí, Brasil. Revistade Ciências Agrárias, 39(1): 455-472.