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# Phenotypic correlation between leaf characters and physical and chemical aspects of cv. Vitória pineapple fruit

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**Abstract –** By considering the few studies related to pineapple cv. Vitória, to know the relationships between the physical and chemical characteristics of the fruits, and they with the "D" leaf, is fundamental. The objective of this work was to evaluate the relationships between "D" leaf, with the physical and chemical characteristics of fruits of pineapple cv. Vitória, under the edaphoclimatic conditions in the North of the State of Espírito Santo. The experiment was carried out in a complete randomized block design in split-plot arrangement with four replications. The data obtained from 433 individually evaluated fruits were analyzed, as it follows: 84 at planting in July and induction at 8 months; 98 at planting in July and induction at 10 months; 84 at planting in July and induction at 12 months; 59 at planting in September and induction at 8 months; 50 at planting in September and induction at 10 months; 58 at planting in September and induction at 12 months. Pearson's correlation was performed between the characteristics of "D" leaf (length and width) and the physical and chemical aspects of fruits (mass of the fruits with and without crown, fruit length and diameter, pulp volume, translucent area, soluble solids and titratable acidity) for the six treatments. Most of the relationships among the 11 characteristics evaluated were of low magnitude in the six treatments, but correlations of high magnitude and practical application of interest to plant scientists, breeders, farmers and consumers were found. The length and width of the "D" leaf should not be used as indicators of physical and chemical qualities of cv. Vitória. Fruits with higher mass, with or without crown or larger width or diameter present higher pulp content. Fruits with higher mass, with or without crown have lower content of soluble solids.

**Index terms**: *Ananas comosus* (L.) Merrill, fruit quality, Pearson correlation.

# Correlação fenotípica entre características foliares e atributos físicos e químicos de frutos de abacaxizeiro cv. Vitória

**Resumo -** Considerando os poucos estudos relacionados ao abacaxizeiro cv. Vitória, conhecer as relações entre as características físicas e químicas dos frutos, e estas com a folha "D", é fundamental. Objetivou-se com este trabalho avaliar as relações da folha "D", com as características físicas e químicas de frutos do abacaxizeiro cv. Vitória, nas condições edafoclimáticas do norte do Estado do Espírito Santo. O ensaio foi conduzido em delineamento de blocos ao acaso, em parcelas subdivididas no tempo, com quatro repetições. Foram analisados os dados obtidos de 433 frutos avaliados individualmente, sendo: 84 no plantio em julho e indução aos 8 meses; 98 no plantio em julho e indução aos 10 meses; 84 no plantio em julho e indução aos 12 meses; 59 no plantio em setembro e indução aos 8 meses; 50 no plantio em setembro e indução aos 10 meses; e 58 no plantio em setembro e indução aos 12 meses. Correlação de Pearson foi realizada entre as características da folha "D" (comprimento e largura) e os aspectos físicos e químicos dos frutos (massa dos frutos com e sem coroa, comprimento e diâmetro dos frutos, volume de polpa, área translúcida, sólidos solúveis e acidez titulável) para os seis tratamentos. A maioria das relações entre as 11 características avaliadas mostrou-se de baixa magnitude nos seis tratamentos, mas houve correlações de alta magnitude e de aplicação prática de interesse a fitotecnistas, melhoristas, agricultores e consumidores. O comprimento e a largura da folha "D" não devem ser usados como indicadores de qualidades físicas e químicas de frutos do abacaxizeiro cv. Vitória. Frutos com maior massa, com ou sem coroa, ou maior largura ou diâmetro apresentam maior teor de polpa. Frutos com maior massa, com ou sem coroa, apresentam menor teor de sólidos solúveis.

**Termos para indexação**: *Ananas comosus* (L.) Merrill, qualidade de fruto, correlação de Pearson.

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## Introduction

Pineapple is a much appreciated fruit all over the world. In 2013, Brazil ranked as the second largest producer, with about 2.5 million tons of harvested fruits, losing only to Costa Rica, with approximately 2.7 million tons (FAO, 2015). Regarding the cropped area, in Espírito Santo, in 2014, the municipality of Marataízes was the largest producer, with 31.108 million fruits harvested. In the northern region of the State of Espírito Santo, despite the low number of producers and few cultivated areas, pineapple cv. Vitória was produced. Such cultivar is resistant to fusariosis, caused by *Fusarium guttiforme* considered the main disease of the crop in Brazil, accounting for the low quality of the fruits and losses of up to 40% of the production (INCAPER, 2010).

Because it is one of the most recent cultivars in the Brazilian market, the pineapple cv. Vitória has been evaluated for its chemical characterization nutrition (CAETANO et al., 2015; FERREIRA et al., 2016), nutritional (MENDONÇA et al., 2017), among others. However, the number of studies is still small, and to know the relationships between the physical characteristics of mass and length of fruits, as well as the chemical characteristics of soluble solids and titratable acidity correlated with "D" leaf becomes a tool indispensable for new studies, besides the possibility of assisting in the improvement of crop management and, consequently, productivity and fruit quality.

Correlation in statistics is a widely used tool since it allows the quantitative evaluation of the relevance of one characteristic in relation to the other. Oliveira et al. (2015), when studying the Pearson's correlation coefficients in the production characteristics of the 'BRS Imperial' pineapple, reported that the significant negative correlation with a higher coefficient of correlation (-0.77) indicates the possibility that the length of the fruit exerts a greater influence on the smallest crown mass than the diameter (-0.45) and mass of the fruit (-0.56). In other words, they concluded that the larger the mass of the fruit, the greater its diameter and length, and the smaller the crown.

Genetic correlation and correlation linked to the environmental factor are the causes of correlation between two characteristics. The association between two directly observed characteristics is the phenotypic correlation (FALCONER, 1981; CARVALHO et al., 2004). Therefore, to know this mechanism also allows to a better evaluation of genetic improvement programs.

To study the correlation is important because it allows to consider the simultaneous analysis of many characteristics in breeding programs. Despite its importance in the prediction of attributes of fruit quality, there are few studies considering the relationships between the characteristics of the pineapple, especially cv. Vitória. So, the objective of this work was to evaluate the relationships of "D" leaf, with the physical and chemical characteristics of fruits of pineapple cv. Vitória, under the edaphoclimatic conditions in the North of the State of Espírito Santo.

## Material and Methods

Two crops with pineapple cv. Vitória were carried out in this study. The former was planted on July 15 and the second on September 1, 2013, on the Experimental farm owned by Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural (Incaper), located at 19º11'30'' S and 40º05'46'' W, in the municipality of Sooretama, Espírito Santo (ES). The soil in the experimental area was a cohesive dystrophic Yellow Red Latosol. The climate of the municipality, according to the classification of Köppen, is of the type Af, being hot, humid tropical with a rainy season in the summer and dry season in the winter. The relief in the region is predominantly flat.

Monthly data on precipitation (mm), reference evapotranspiration (mm), average temperature (°C), air relative humidity (%) and thermal sum (degrees days) are shown in Figure 1. Data were obtained through the automatic weather station in Linhares/ES, owned by Instituto Nacional de Meteorologia-INMET (19°21'S and 40°04'W).

Offspring type seedlings of cv. Vitória, measuring and weighing, on average, 33 cm and 150 g, respectively, acquired from the Incaper farm in Sooretama-ES were used. The seedlings remained in a shaded place for about five days for cure of the base, after which they were immersed for five minutes in a volume containing insecticide registered for the culture and seven days, they remained in a shaded place for the second cure. The plantings were made in furrows and arranged in double row spacings with 0.9 x 0.4 x 0.30 m, that is, 0.9 m between the double rows, 0.4 m between the rows of each double row and 0.3 m between plants under non-irrigated cultivation and fertilized according to the results of the soil analysis, following the recommendation for manual liming and fertilization for the State of Espírito Santo (PREZOTTI et al., 2007), for the cultivation of pineapple. The soil chemical analysis showed the following results: pH in water: 6.2; P (Mehlich 1): 32.9 mg $dm^{-3}$; K: 167 mg $dm^{-3}$; Na: 167 mg $dm^{-3}$; $Ca^2$: 2.86 cmolc $dm^{-3}$; $Mg^2$: 0.78 cmolc $dm^{-3}$; $Al^3$: 0.0 cmolc $dm^{-3}$; H + A: 2.1 $cmol_c$ $dm^{-3}$; SB: 4.10 cmols; Effective CTC (t): 4.10 $cmol_c$; CTC at pH 7.0 (T): 6.20 $cm^{-1}$; V: 66.1%; m: 0.0%: Na saturation index: 0.64%; MW: 1.24 dag $kg^{-1}$; Zn: 17.4; Fe: 38.8 mg $dm^{-3}$; Mn: 19.7 mg $dm^{-3}$; Cu: 1.31 mg $dm^{-3}$; B: 1.0 mg $dm^{-3}$. All necessary cultural practices were carried out for the proper development of the crop, as well as the control of weeds and pests.

The plants were induced at 8, 10 and 12 months of age, and the artificial floral induction was performed with commercial Ethrel® product (Ethephon) at 240 g $L^{-1}$ with addition of 2% urea at a dose of 30 mL per plant applied over leaf rosette with the aid of a packback sprayer (Bayer

CropScience, 2005), in the early morning, between 08:30 and 09:30, in stable weather conditions.

The experiment was carried out in a randomized complete block design in split plot with four replications. The main plot represented the different planting seasons, corresponding to July and September 2013, and the subplots were represented by the different periods of floral induction corresponding to the ages of 8, 10 and 12 months, totaling six treatments. The data obtained from 433 fruits manually harvested at the maturation stage corresponding to the painted (up to 25% of its orange-yellow peel) were analyzed, according to Normative Instruction/SARC No. 001 of February 1, 2002, for white pulp pineapple (BRASIL, 2002), and packed in plastic boxes for transportation. Their evaluations were individual and in the following periods: 84 (planting in July and induction at 8 months); 98 (planting in July and induction at 10 months); 84 (planting in July and induction at 12 months); 59 (planting in September and induction at 8 months); 50 (planting in September and induction at 10 months); 58 (planting in September and induction at 12 months). Harvesting was performed after 5, 6 and four months of floral induction of plants at 8, 10 and 12 months after planting, respectively.

After harvesting, the fruits were sent to the Post-Harvest Plant Physiology Laboratory of the Regional Development Center of Linhares, Incaper, where the biometric and biochemical measurements were obtained, along with the length and width of the "D" leaf, which were recorded at the time of artificial induction. The data regarding the characteristics evaluated, as well as the methodology used in pineapple cv. Vitória are shown in Table 1.

Descriptive statistics of the 433 fruits, for each of the 11 characteristics was made by the evaluation of the minimum, maximum, average values and coefficient of variation. The visualization of the relationships between the 11 evaluated characteristics, two by two, for the six treatments, were made by graphic dispersion.

The study of phenotypic relationships was done using Pearson's linear correlation by applying it in the relationships between the 11 characteristics, two by two, for the six treatments, totaling 330 correlation values. The statistical comparison of the values of the correlations between the six treatments ($r_i$), for each pair of characteristics, was made using Fisher's transform of $r_i$ according to Ferreira (2009), in which, for the experiment in question, the following hypotheses are made: $H_0$: $\rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_5 = \rho_6 = \rho$ vs $H_1 : \rho_i \neq \rho$ for at least one i = 1, 2, ..., 6 treatments, where ρ is the population correlation.

The Pearson's correlation analysis had the magnitudes classified according to Shimakura and Ribeiro Júnior (2012), where, regardless of the sign, a correlation is considered very weak between 0.00 and 0.19; weak, between 0.20 and 0.39; moderate, from 0.40 to 0.69; strong, between 0.70 and 0.89 and very strong, between 0.90 and 1.00.

Statistical analyzes were performed using the statistical program Genes (CRUZ, 2016) and R (R Development Core Team, 2017).

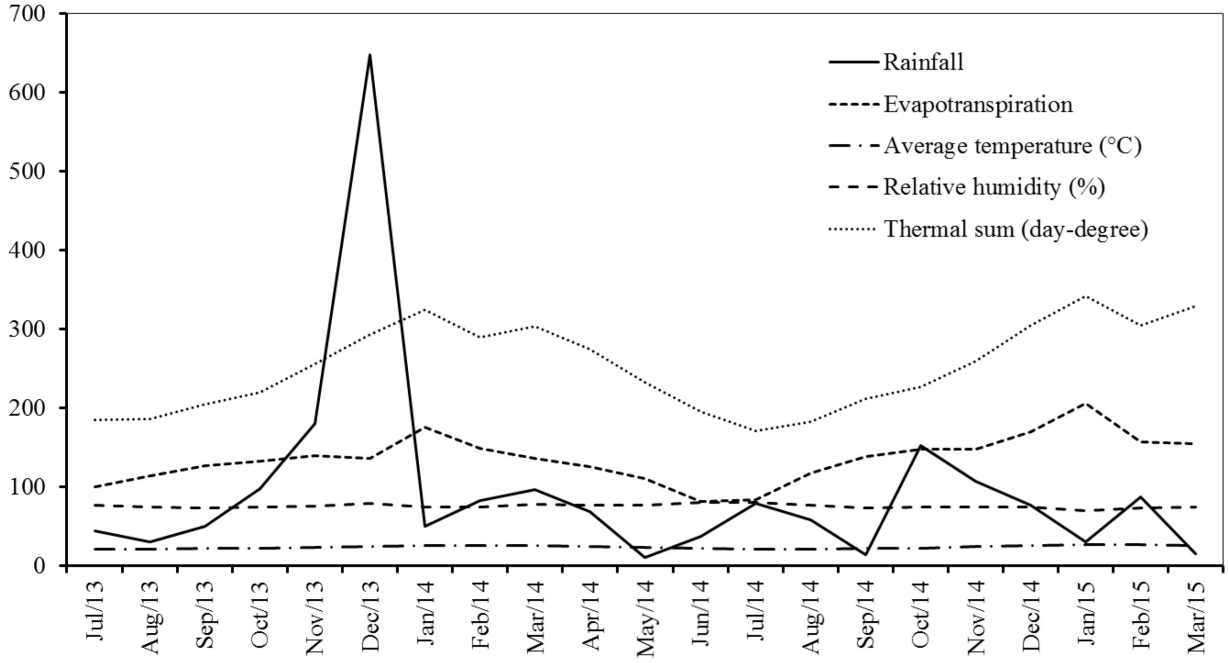


**Figure 1** – Weather data and monthly thermal sum during experiment with cv. Vitória pineapple in the municipality of Sooretama-ES, 2013-2015. Source: Automatic weather Station of Linhares/ES, owned by Instituto Nacional de Meteorologia – INMET (19°21'S; 40°04'W).

**Table 1-** Name, unit, and methodology for collection and analysis of cv. Vitória fruits cropped in Sooretama-ES.

| Characteristics | Abbreviation | Methodologies |
|---|---|---|
| | | "D" leaf characteristics |
| "D" leaf length (cm) | LL | Measured using a millimeter ruler, where one "D" leaf was measured per plant. |
| "D" leaf width (cm) | LW | Measured using a millimeter ruler on the lower third of the leaf, where one "D" leaf was measured per plant. |
| | | Biometric characteristics and fruit biomass |
| Mass of the fruit with crown (g) | MFC | Individual weighing carried out on a Marconi, no. AS5500C electronic scale. |
| Mass of the fruit without crown (g) | MFW | Individual weighing carried out on a Marconi, no. AS5500C electronic scale. |
| Fruit length (cm) | FL | Measured using a millimeter ruler from one end to the other. |
| Fruit diameter (cm) | FD | Fruit sectioned in the middle on the median portion. Measured using a millimeter ruler. |
| Central cylinder diameter (cm) | CCD | Fruit sectioned in the middle on the median portion. Measured using a millimeter ruler. |
| | | Fruit biochemical characteristics |
| Pulp volume (mL) | PV | The fruits were peeled and centrifuged in a Mondial Premium and measured with a beaker. |
| Translucent area (%) | TRA | The pulp was classified according to Martins et al. (2012) in: 1. completely opaque pulp; 2. pulp with up to 10% of translucent area; 3. pulp with 11% to 25% of translucent area; 4. 26% to 50% of translucent area; 5. pulp with 51% to 75% translucent area; and 6. with more than 75% of translucent area. |
| Soluble solids (°Brix) | SS | Soluble solids were determined in the juice. The ATAGO refractometer, model PZO RR11, Nr. 20700, 0-35 ° Brix, was used with temperature compensation at 20 °C. The standards specified by Instituto Adolfo Lutz (IAL, 2008) were followed. |
| Titratable acidity (% citric acid) | TA | It was expressed in citric acid percentage according to the methodology standardized by Instituto Adolfo Lutz (IAL, 2008). |

## *Results and discussion*

Biometric and biochemical measurements of leaf and fruits of pineapple cv. Vitória are found in Table 2. The values of 56.1 cm and 4.4 cm in length and average width, respectively, for "D" leaf, were recorded (Table 2). Similar results were reported by Francisco et al. (2014), who observed values of 56.8 cm in length and 6.2 cm in width, using cv. Vitória seedlings propagated *in vitro*, planted in a greenhouse and induced to flowering at nine months.

Pegoraro et al. (2014) and Vilela et al. (2015), working with pineapple cv. Vitória, irrigated, grown between March and April 2009 and induced in July 2010, obtained 82 cm and 86.75 cm in length of "D" leaf, respectively, that is, a difference of up to 30.65 cm in relation to plants of the present study. The observed difference in the growth of "D" leaf probably occurred due to non-irrigation and water deficit observed in some months (Figure 1), considering that to provide 60 to 100 mm of water per month is the ideal to ensure higher productivity and fruit quality (PY et al., 1984). However, the different environmental conditions to which the plants of the different planting and floral induction seasons were submitted are suitable for the comparative study of the correlations since they allow to verify the environmental action in the values of the correlations. According to Souza et al. (2012), the length (L) and width (W) of leaf "D" vary greatly among genetic materials, as observed with *A. comosus* var. *comosus* in cvs. Arroba Tarauacá (L= 84.92 cm and W = 4.82 cm), Roxo de Tefe (L = 95 cm and W = 3.9 cm), Branco (L = 93 cm and W = 7.1 cm), FRF-747 (L = 85.5 cm and W = 4.5 cm) and LBB-608 (L = 67 cm and W = 3.75 cm).

The average values of fruit mass observed in this study were 794.5 g for fruits with crown and 694.9 g for crownless fruits (Table 2), values below those obtained by Berilli (2010), with cv. Vitória pineapple, planted in June 2008 and with artificial floral induction performed at 13 and 14 months, which were 1141.0 g of fruit mass with crown and 1060.0 g for crownless fruit mass. The water deficit, as well as other climatic factors (Figure 1), are

likely to have influenced these characteristics; however, it is important to note that the floral induction carried out by the author was late compared to the present study, which may also interfere with the achieved results.

Other important biometric attributes for the definition of fruit quality are its length and diameter, which ensure greater acceptance of the product by the consumer market, which is motivated to purchase due to its size and format. In this work, values of the length and average diameter of the fruits of 11.50 cm and 9.8 cm, respectively (Table 2) were observed. However, Berilli (2010) obtained higher values of length (13.6 cm) and diameter (10.8 cm) in cv. Vitória pineapple fruits, probably due to the greater plant growth equivalent to the time interval between planting and floral induction (13 and 14 months), since more developed plants tend to produce larger fruits.

The average of central cylinder diameter was 1.0 cm (Table 2). In studies conducted by Berilli (2010) and Andrade et al. (2015), when evaluating fruits of pineapple cv. Vitória, values of 0.98 cm and 1.22 cm, respectively, were found by those authors. This characteristic is directly related to the yield of the pulp, because it represents the inner part of the inedible fruit, that is, the smaller the diameter of the central cylinder, the greater its pulp yield.

The results obtained in this experiment for pulp volume and translucent area of pineapple fruits cv. Vitória were 309.5 mL and 3.8 (11 to 25%), respectively (Table 2). Martins et al. (2012), when studying the post-harvest conservation of pineapple cv. Pérola produced in the conventional and integrated systems, and harvested at the commercial maturity point, reported values between 3 (11 to 25% of translucent area) and 4 (26 to 50% of translucent area), respectively. According to these authors, the translucency of pineapples from integrated (IP) and conventional (CP) production systems increased during storage.

The average value of soluble solids in the present study was 14.2° Brix (Table 2), close to 14.45° Brix and 13.3° Brix verified by Andrade et al. (2015) and by Caetano et al. (2015) in fruits of pineapple cv. Vitória.

The average titratable acidity presented a value of 0.8% (Table 2), similar to those found by Silva et al. (2012), which was between 0.7 and 0.8% in fruits from flowering-induced plants at 420 days (14 months) and fertilized with 600 kg $ha^{-1}$ of N. Andrade et al. (2015) obtained 0.72% titratable acidity in conventional tillage fruits harvested at a commercial maturity point.

Through Normative Instruction/SARC No. 001 of February 1, 2002, the Brazilian Ministry of Agriculture, Livestock and Supply determines marketing standards for pineapple of yellow and white pulp of at least 12° Brix. This confirms the good quality of the fruit of the pineapple cv. Vitória given its adequate sensorial and chemical characteristics studied in the present work.

In the graphical dispersion shown in Figure 2, it can be observed that most of the pairs of characteristics present low magnitude linear relationships. In Figure 2, it is also easy to verify that there are high magnitude and coherent linear relationships between the six treatments, such as the mass of fruit with crown and the crownless fruit mass. The 330 linear correlation values of Pearson and their statistical comparisons among the six treatments for the 55 pairs of characteristics are presented in Figure 3.

A moderate magnitude correlation, according to the classification of Shimakura and Ribeiro Júnior (2012) is observed between the length and width of "D" leaf (Figure 3) evaluated in the six treatments. According to Francisco et al. (2014), among the indicators that helped in the validation of the linear model for the determination of leaf area of pineapple cv. Vitória, the high correlation value of Person (r = 0.9675**) is found. Additionally, the product of leaf dimensions (length x width) is the most

**Table 2 –** Average, minimum and maximum and coefficient of variation (CV) for 11 characteristics of cv. Vitória pineapple cropped in Sooretama-ES, 2015.

| Characteristics | Average | Minimum | Maximum | CV (%) |
|---|---|---|---|---|
| "D" leaf length (cm) | 56.1 | 18.0 | 82.5 | 22.3 |
| "D" leaf width (cm) | 4.4 | 2.2 | 6.4 | 20.7 |
| Mass of the fruit with crown (g) | 794.5 | 72.2 | 1695.9 | 46.4 |
| Mass of the fruit without crown (g) | 694.9 | 61.4 | 1596.8 | 50.9 |
| Fruit length (cm) | 11.5 | 3.7 | 18.6 | 26.4 |
| Fruit diameter (cm) | 9.8 | 4.2 | 13.7 | 18.2 |
| Central cylinder diameter (cm) | 1.0 | 0.3 | 1.9 | 26.3 |
| Pulp volume (mL) | 309.5 | 20.0 | 860.0 | 57.2 |
| Translucid area (%) | 3.8 | 1.0 | 6.0 | 37.7 |
| Soluble solids (°Brix) | 14.2 | 9.7 | 17.6 | 12.5 |
| Titratable acidity (% citric acid) | 0.8 | 0.3 | 1.2 | 19.0 |

accurate biometric feature to estimate the leaf area.

The correlations between the biometric characteristics of "D" leaf (length and width) and the physical (mass of the fruit with crown, mass of fruit without crown, fruit length, fruit diameter, central cylinder diameter, pulp volume and translucid area) and chemical characteristics (soluble solids and titratable acidity) were of low magnitude, classified as very weak and weak, according to classification of Shimakura and Ribeiro Júnior (2012) (Figure 3). These results differ from those reported by Caetano et al. (2013), whose length of the "D" leaf, determined at the time of floral induction, presented a moderate correlation with the mass, length, and diameter of the fruit of pineapple cv. Vitória grown at different levels of nitrogen, phosphorus, and potassium. It should be noted, however, that the estimates of the correlations made by Caetano et al. (2013), were for the set of all data among the pairs of characteristics, different from what had been done in this work. Figure 2 illustrates that when all data from the six treatments are used, the linear relationship is very clear. In fact, if the correlation is determined for all 433 fruits, this correlation will be 0.58 and, therefore, of moderate magnitude, as observed by Caetano et al. (2013).

Mass of the fruit with crown showed correlation values with fruit widths statistically different among the six treatments (Figure 3). However, this statistical difference can be neglected, since the correlation values ranged from 0.77 to 0.95, classified as strong and very strong. The same behavior was verified in the correlation between the mass of fruits with crown and the diameter of the fruit, as well as with the volume of pulp. These same relationships can be made to the fruit without crown since the correlation between fruits with and without crown is 0.99. A strong correlation between fruit diameter and pulp volume was found (Figure 3). It can be inferred that the diameter of the fruit because it is a non-destructive characteristic, is an excellent indicator of fruit mass and pulp volume. Caetano et al. (2013) reported a narrow relationship between fruit length and diameter with fruit mass, and Vilela et al. (2015), working with pineapple cv. Vitória, irrigated, planted between March and April 2009 and induced in July 2010, obtained a high correlation (r = 0.93) between fruit diameter and fruit mass, and these results corroborate with those found in the present study.

A moderate correlation was observed between the mass of the fruit with and without crown with the translucent area (Figure 3), however, only in the fruits of the plants planted in September, however, the correlations were weak when evaluated in the fruits of the July planting. Despite the differences in the magnitudes of these correlations for the two planting seasons, they are statistically equal, and therefore, the largest fruit mass should not be used as indicative of higher fruit translucency.

The fruit mass with and without crown and the pulp volume had a negative correlation and of moderate magnitude with the soluble solids content (Figure 3). Therefore, heavier fruits tend to have a lower soluble solids content.

It was also observed that the mass of the fruit was not influenced by the mass of the crown. As a result, the commercialization of the fresh fruit can be carried out without any loss to the final consumer, since the mass of the crown influences only about 100 grams more (Table 2) of the fruit mass.

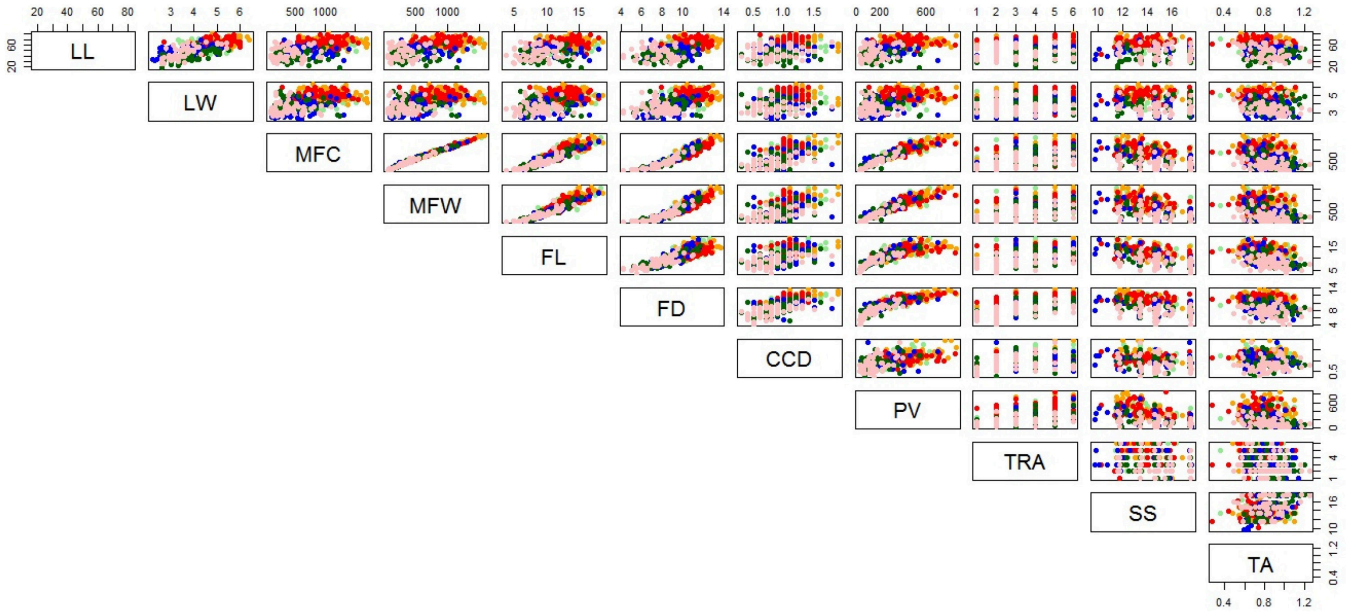


**Figure 2** – Graphic dispersion to 11 pairs of characteristics of cv. Vitória pineapple cropped in different environments in Sooretama-ES, 2015.

Legend: LL: "D" leaf length; LW: "D" leaf width; MFC: mass of the fruit with crown; MFW: mass of the fruit withouth crown; FL: fruit length length; FD: fruit dimater; CCD: central cylinder diameter; PV: pulp volume; TRA: tranlsucidal area; SS: soluble solids; TA: titratable acidity.

| Characteristics | Treatment | Characteristics | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | LW | MFC | MFW | FL | FD | CCD | PV | TRA | SS | TA |
| LL | EP1EI1 | 0.41a | 0.26a | 0.21a | -0.03a | 0.31a | 0.18a | 0.18a | 0.34a | 0.07a | -0.17a |
| | EP1EI2 | 0.40a | 0.12a | 0.10a | 0.00a | 0.16a | 0.01a | 0.09a | 0.09a | -0.01a | 0.00a |
| | EP1EI3 | 0.44a | 0.12a | 0.14a | 0.21a | 0.01a | -0.14a | 0.08a | 0.18a | -0.01a | 0.06a |
| | EP2EI1 | 0.57a | 0.04a | -0.02a | -0.05a | 0.16a | 0.05a | -0.07a | 0.25a | 0.22a | 0.02a |
| | EP2EI2 | 0.58a | 0.02a | -0.02a | -0.12a | 0.10a | 0.07a | 0.00a | 0.06a | 0.19a | 0.13a |
| | EP2EI3 | 0.69a | 0.14a | 0.16a | 0.20a | 0.08a | 0.12a | 0.21a | -0.05a | -0.08a | -0.35a |
| LW | EP1EI1 | | 0.11a | 0.15a | 0.25a | -0.13a | -0.01a | 0.02a | -0.01a | -0.13a | -0.16a |
| | EP1EI2 | | -0.03a | -0.04a | -0.01a | 0.01a | -0.01a | 0.08a | -0.07a | -0.03a | 0.21a |
| | EP1EI3 | | 0.02a | 0.01a | -0.05a | 0.07a | 0.06a | 0.07a | 0.17a | -0.02a | 0.10a |
| | EP2EI1 | | 0.43a | 0.39a | 0.33a | 0.39a | 0.01a | 0.30a | 0.27a | -0.17a | -0.09a |
| | EP2EI2 | | -0.03a | -0.06a | -0.09a | 0.07a | -0.18a | -0.04a | -0.09a | 0.18a | 0.18a |
| | EP2EI3 | | -0.03a | -0.04a | 0.02a | -0.01a | -0.02a | 0.02a | 0.03a | 0.00a | -0.18a |
| MFC | EP1EI1 | | | 0.99a | 0.77b | 0.80b | 0.52a | 0.81b | 0.24a | -0.43a | -0.20a |
| | EP1EI2 | | | 0.99a | 0.80b | 0.87a | 0.62a | 0.88ab | 0.34a | -0.41a | -0.04a |
| | EP1EI3 | | | 0.99a | 0.82b | 0.87a | 0.50a | 0.85b | 0.22a | -0.40a | -0.10a |
| | EP2EI1 | | | 0.99a | 0.95a | 0.93a | 0.33a | 0.92ab | 0.48a | -0.54a | -0.44a |
| | EP2EI2 | | | 0.99a | 0.94a | 0.94a | 0.46a | 0.94a | 0.59a | -0.68a | -0.42a |
| | EP2EI3 | | | 0.99a | 0.88ab | 0.92a | 0.61a | 0.94a | 0.58a | -0.44a | -0.27a |
| MFW | EP1EI1 | | | | 0.82c | 0.77b | 0.51a | 0.81b | 0.22a | -0.42a | -0.19a |
| | EP1EI2 | | | | 0.86c | 0.85a | 0.61a | 0.88b | 0.30a | -0.40a | -0.05a |
| | EP1EI3 | | | | 0.85c | 0.84a | 0.50a | 0.85b | 0.21a | -0.43a | -0.08a |
| | EP2EI1 | | | | 0.97a | 0.90a | 0.33a | 0.92ab | 0.41a | -0.56a | -0.44a |
| | EP2EI2 | | | | 0.96ab | 0.92a | 0.41a | 0.95a | 0.55a | -0.68a | -0.44a |
| | EP2EI3 | | | | 0.90bc | 0.89a | 0.59a | 0.95a | 0.53a | -0.40a | -0.30a |
| FL | EP1EI1 | | | | | 0.43b | 0.33a | 0.59b | 0.04a | -0.30b | -0.24a |
| | EP1EI2 | | | | | 0.54b | 0.44a | 0.66b | 0.11a | -0.35b | -0.22a |
| | EP1EI3 | | | | | 0.52b | 0.35a | 0.64b | 0.04a | -0.36b | -0.12a |
| | EP2EI1 | | | | | 0.82a | 0.27a | 0.91a | 0.35a | -0.63ab | -0.48a |
| | EP2EI2 | | | | | 0.84a | 0.34a | 0.88a | 0.46a | -0.73a | -0.55a |
| | EP2EI3 | | | | | 0.82a | 0.43a | 0.87a | 0.41a | -0.39b | -0.34a |
| FD | EP1EI1 | | | | | | 0.69a | 0.70a | 0.15b | -0.34a | 0.10a |
| | EP1EI2 | | | | | | 0.63a | 0.82a | 0.32a | -0.47a | 0.09a |
| | EP1EI3 | | | | | | 0.53a | 0.75a | 0.28a | -0.19b | -0.12a |
| | EP2EI1 | | | | | | 0.41a | 0.80a | 0.48a | -0.38a | -0.37a |
| | EP2EI2 | | | | | | 0.45a | 0.85a | 0.58a | -0.63a | -0.28a |
| | EP2EI3 | | | | | | 0.62a | 0.84a | 0.54a | -0.24a | -0.23a |
| CCD | EP1EI1 | | | | | | | 0.40a | 0.04a | -0.34a | -0.01a |
| | EP1EI2 | | | | | | | 0.55a | 0.12a | -0.37a | 0.13a |
| | EP1EI3 | | | | | | | 0.38a | 0.08a | -0.07a | -0.18a |
| | EP2EI1 | | | | | | | 0.26a | 0.16a | -0.05a | -0.04a |
| | EP2EI2 | | | | | | | 0.37a | 0.22a | -0.36a | 0.02a |
| | EP2EI3 | | | | | | | 0.52a | 0.41a | -0.18a | 0.06a |
| PV | EP1EI1 | | | | | | | | 0.19a | -0.40a | 0.04a |
| | EP1EI2 | | | | | | | | 0.34a | -0.46a | 0.08a |
| | EP1EI3 | | | | | | | | 0.19a | -0.50a | -0.03a |
| | EP2EI1 | | | | | | | | 0.46a | -0.52a | -0.37a |
| | EP2EI2 | | | | | | | | 0.50a | -0.61a | -0.37a |
| | EP2EI3 | | | | | | | | 0.49a | -0.42a | -0.35a |
| TRA | EP1EI1 | | | | | | | | | 0.04a | -0.19a |
| | EP1EI2 | | | | | | | | | -0.17a | -0.12a |
| | EP1EI3 | | | | | | | | | -0.01a | 0.04a |
| | EP2EI1 | | | | | | | | | -0.05a | -0.02a |
| | EP2EI2 | | | | | | | | | -0.33a | -0.20a |
| | EP2EI3 | | | | | | | | | -0.26a | -0.04a |
| SS | EP1EI1 | | | | | | | | | | -0.26c |
| | EP1EI2 | | | | | | | | | | -0.10c |
| | EP1EI3 | | | | | | | | | | 0.02bc |
| | EP2EI1 | | | | | | | | | | 0.47ab |
| | EP2EI2 | | | | | | | | | | 0.57a |
| | EP2EI3 | | | | | | | | | | 0.17abc |

**Figure 3 –** Pearson's linear correlation coefficients among 11 characteristics of cv. Vitória pineapple cropped in Sooretama-ES, 2015.

Legend: EP1 and EP2 = planting in July and September 2013; EI, EI2, EI3 = induction at 8, 10 and 12 months. Very weak correlation between 0.00 and 0.19; weak between 0.20 and 0.39; moderate from 0.40 to 0.69; strong between 0.70 and 0.89 and very strong between 0.90 and 1.00, according to Shimakura and Ribeiro Júnior (2012), regardless of the sign. Legends: LL: "D" leaf length; LW: "D" leaf width; MFC: mass of the fruit with crown; MFW: mass of the fruit without crown; FL: fruit length; FD: fruit diameter; CCD: central cylinder diameter; PV: pulp volume; TRA: translucent area; SS: soluble solids; TA: titratable acidity.

## Conclusions

The length and width of the "D" leaf should not be used as indicators of physical and chemical qualities of cv. Vitória pineapples. Fruits with higher mass, with or without crown or larger width or diameter present higher pulp content. Fruits with higher mass, with or without crown have lower content of soluble solids.

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