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ANATOMY OF CASSAVA LEAVES

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Abstract

Leaves are the organs in which occurs mainly photosynthesis enabling the transformation of radiant energy into chemical energy. Anatomical properties in leaves are indices used in taxonomical studies the importance of anatomical features on the studies support morphological evidence for separating taxa of plants *Manihot* at the generic level. The present study is aiming to introduce an internal description of leaves of cassava plants to determine its characteristics and thus contribute to other research that may need this description. The observation was surface replicas of the leaf made from transparent materials and scanning electron microscopy (SEM) were compared for their ability to present an accurate picture of the leaf. According to the observations, we can infer that, cassava is presented as a very rustic plant by adapting to different environments. The completion of the anatomical study of leaf *Manihot esculenta* IAC 576-70, showed that the sheet, the body responsible the synthesis of carbohydrates and chief of tuberization root has important morpho-anatomical features, such as presence papillae on the abaxial epidermis by increasing the surface forming a crown around the stomata, thereby contributing to the same remain open for longer in areas with water deficit.

Keywords: Abaxial and adaxial surface, *Manihot esculenta* Crantz, Papillae cells, electron microscopy

Introduction

Cassava belongs to the *Euphorbiaceae* family, one of the largest within the dicots. In this family, are found 290 genera and approximately 7,500 species distributed throughout the tropical and subtropical regions of the globe. The tubers, part of the root system and the leaves are used as food sources. It is an important staple in many developing countries of Africa, South and Central America, India and Southeast Asia (Al Afas et al, 2006).

The cassava plant is a perennial that, under cultivation, grows to a height of about 2,4 m. The leaves are large and palmate and have five to seven lobes borne on a long, slender petiole. The leaves grow only towards the end of the branches. They are dark green above and light green below. The gender *Manihot esculenta* Crantz is an herbaceous plant when woody when young and old, presents shrub and canopy branched averagely. The main stem suffers nearest branch of base and the branches are covered with numerous scars from the leaves lapsed.

Anatomical properties are indices used in taxonomical studies for more than hundred years (Radford et al., 1974). Studies indicated the importance of anatomical features on the palaeobotanical and taxonomical studies. Kantachok et al. (2007) stated that leaf anatomical data support morphological evidence for separating taxa of plants *Manihot* at the generic level. Ali et al. (2009) focused on the anatomical adaptation of leaves in the genus *Eucalyptus* from the Faisalabad region. The present study is aiming to introduce an internal description

of leaves of cassava plants to determine its characteristics and thus contribute to other research that may need this description.

Materials and Methods

Fresh material of specie *Manihot esculenta* Crantz of cultivate IAC 576-70 of cassava was collected from crop in area experiment in Brazil in state of São Paulo. The leaves were prepared by macerating in Jeffrey's solution, and therefore mounted in safranin-stained glycerine jelly. For sectioning, fresh material of leaves, petioles and stems was fixed at least 48 hours in formalin acetic acid alcohol solution (FAA) and preserved in 70% alcohol, then dehydrated in ethyl alcohol series, sectioned on a rotary microtome and stained in safranin and fast green and then mounted in balsam (JOHANSEN, 1940; DITCHER, 1974; MELVILLE, 1976).

To observation of parts anatomical was performed using an optical microscope eyepiece lens 15x and objective lens 40x was used, which provided 600x magnification and a field of view of 0.39mm2. The images used for analysis were captured by a capture system composed of a microscope equipped with camera AxioCam ICc3 and Bel View software. Image processing and analysis was performed with public domain software Image J 1.43a, version 64, with the measurement of five fields replicated for each analyzed leaf (NORTH, 1956).

Results and Discussion

Anatomical analysis of the limbo of IAC 576-70, in cross section, revealed that the epidermis cells adaxial with format predominantly rectangular in between the ribs area. The outer periclinal walls are straight and covered with cuticle and anticlinal walls are slightly winding (see Figure 1A). On the abaxial surface, the epidermis forming papillae cells with an only more or less conical dome surface (see Figure 1B). The papillae are distributed throughout the epidermis that face but on the primary ribs secondary and have a more rounded shape with smaller domes projection.

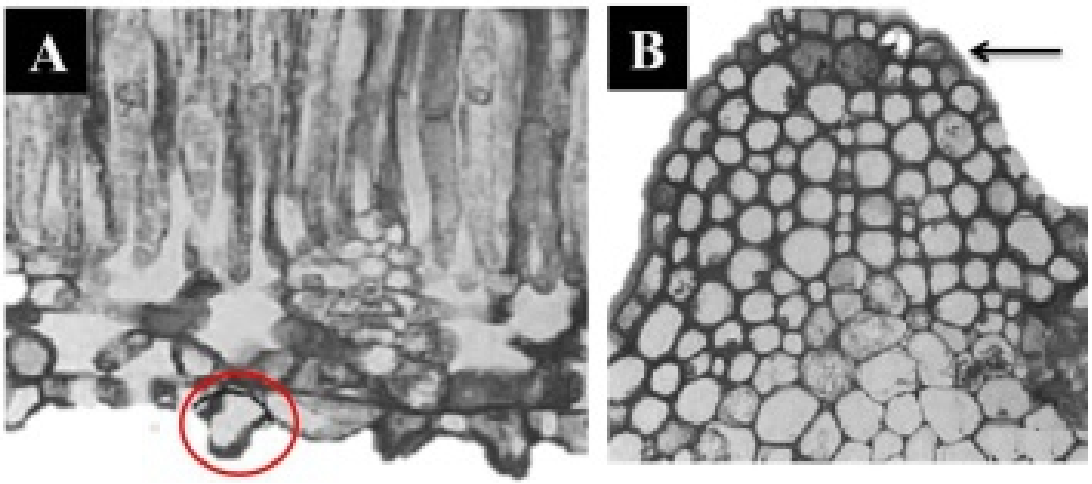


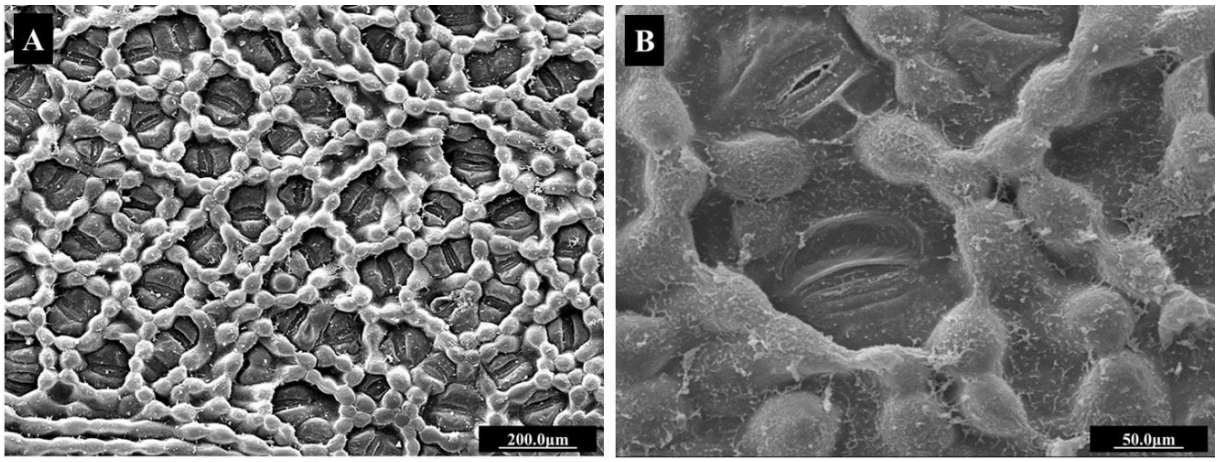
Figure 1 – General appearance of the leaf blade. Observe epidermal cells of rectangular shape on the adaxial surface and papillae on the abaxial face (circle) (A) (22µm). Detail of the rib region primary leaf blade. Observed in the abaxial epidermis, cells rounded contour and cuticle (arrow) (B) (25µm).

On primary and secondary veins, external periclinal cell walls in adaxial epidermis possess rounded contour. In beams of smaller caliber, the epidermal cells on the adaxial little, however, alter the abaxial presented slightly papillose.

With the use of scanning electron microscope, cells forming papillae with a more or less conical dome was observed on the abaxial surface of leaves (see Figure 2A). These

papillae are distributed throughout the epidermis of this surface. However, beside the primary and secondary ribs, they have a round shape, with smaller domes, in front view, these cells form a crown around the stomata (see Figure 2B).

Figure 2 – Epidermis cells of the leaf upper side with papillae (A). Papillae cells form a crown around the stomata (B).



Similar features were found in the epidermis of the adaxial *Manihot caerulescens* described by Mendonça (1983). In *Manihot glaziovii*, Mendonça (1992) noted the occurrence of rectangular cells, with walls often pointed external periclinal, resembling sometimes with papillae. In Manihot esculenta, the papillae cells are present only on the abaxial surface and occur in every area of the leaf blade where there venation network. These results are similar to those obtained by Oliveira and Miglioranza (2013), who observed the presence of papillae partially surrounding the stomata.

Works such as Mantovani and Vieira (1997) reported that the presence of papillae on the abaxial epidermis can contribute to improving the reception of light on plants growing under the canopy of tropical forests. Whereas *M. esculenta* is a plant grown in full sun, the presence papillae on the abaxial side seems to have the primary function of protecting stomata, since spread like a crown around them. However, prove the function of the papillae as lenses converge the lights for chlorophyllian tissues, needs further studies.

Hairs unicellular, unbranched, short and thin type, also were found in the epidermis. These are distributed sparsely in both faces, especially on the primary and secondary veins (see Figure 3). According to Mantovani and Vieira (1997), the family *Euphorbiaceae*, occur many types of hair that vary in density and shape, including glandular hairs, non-glandular types and thorns.

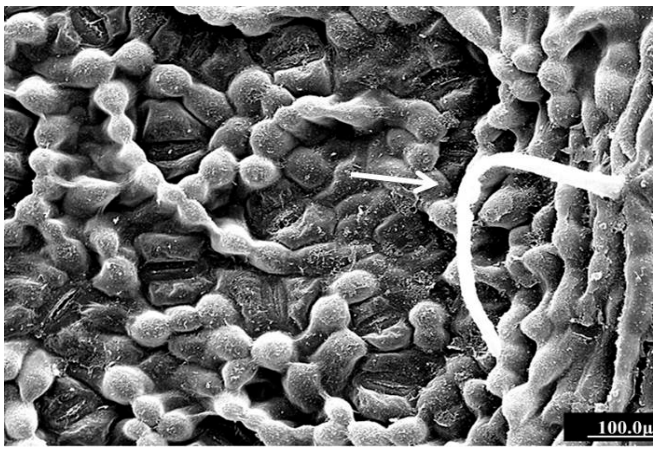


Figure 3 – Aspect abaxial showing the presence of single hair located on the main rib (arrows) of the sheet.

The sheet is amphistomatic *M. escuenta* and the stomata, the type paracitic (see Figure 4), is present mainly on the abaxial surface surrounded by papillae, which form a crown around her. The stomata of the face adaxial are located slightly below the other epidermal cells, and front view, are present only near the upper ribs review, which is in accordance with the descriptions Oliveira and Miglioranza (2014), who also reported the presence of stomata, usually on the face abaxial, but rarely occur on both sides *within Euphorbiaceae.*

The largest amount of stomata on the abaxial surface, surrounded by buds may favor the control opening and closing of stomata on the leaf and so increase their photosynthetic capacity. This seems possible because it turns out that stomata present on the abaxial surface of *M. esculenta* are closed in the presence of dry air, which allows the plant to survive for long periods of water shortage and maximize the use of water. Furthermore, the leaves demonstrated considerable ability to recycle the CO_2 from your breath.

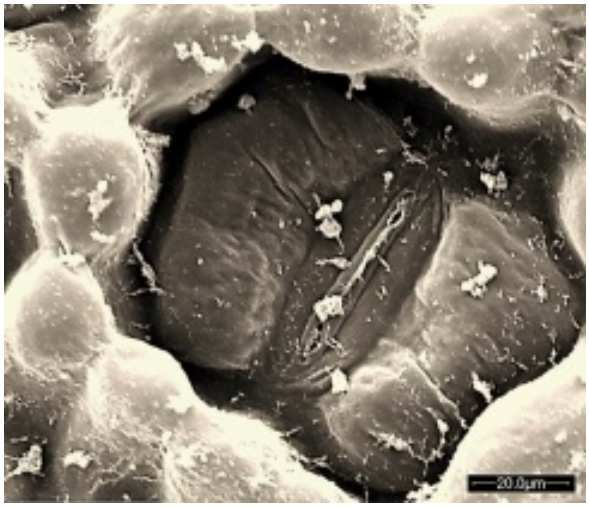


Figure 4 – stomata, the type paracitic present on the abaxial surface surrounded by papillae cells, which form a crown around her.

Conclusion

Cassava is presented as a very rustic plant by adapting to different environments. The completion of the anatomical study of leaf *Manihot esculenta* IAC 576-70, showed that the sheet, the body responsible the synthesis of carbohydrates and chief of tuberization root has important morpho-anatomical features, such as presence papillae on the abaxial epidermis by increasing the surface forming a crown around the stomata, thereby contributing to the same remain open for longer in areas with water deficit.

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