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Description of cultivar

Guanay-1, Guanay-2 and Guanay-3: new varieties of soursop for Nayarit

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Abstract

In Nayarit, soursop is propagated sexually, so its fruits have a variable morphology, shape and size, this has allowed the selection and evaluation of materials that have advantages compared to other genotypes of the same species and that contribute to genetic improvement. Its fruits are rich in fiber, minerals and bioactive compounds. The objective of this contribution is to disseminate the morphological and physicochemical characteristics of three new varieties of soursop Guanay-1, Guanay-2 and Guanay-3. The study was conducted in 2016-2018, trees that were ungrafted, vigorous and free of pests and diseases (19 years old) were selected, morphological and physicochemical characteristics of fruits at maturity of consumption were evaluated. The fruits of Guanay-1: were heart-shaped, length of 17.09 cm, average weight of 1 438.79 g and 86 seeds on average, the stylar protuberances measured 0.5 mm in length; in Guanay-2: the shape of the fruit was irregular, length of 25.31 cm, average weight of 1 948.1 g and 166 seeds, the stylar protuberances measured 2.05 mm in length; in Guanay-3: the shape of the fruit was conical, with length of 21.17 cm, average weight of 902.27 g and 231 seeds, stylar protuberances of 7.56 mm in length. The firmness and titratable acidity of Guanay-1 was 24.6 N and 0.6% respectively, Guanay-2 and Guanay-3 registered a firmness of 8 N and acidity of 0.9%. In conclusion, morphological characteristics were the basis for the selection and registration of these varieties that contribute to the technological development of soursop cultivation in Nayarit.

Keywords: *Annona muricata* L., morphology, selection, varieties.

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Soursop (*Annona muricata* L.) belongs to the family Annonaceae, is native to Mexico and Central America, is characterized by growing mainly in the tropics (Nugraha *et al*., 2019); nevertheless, it is also distributed in East and West Africa and Southeast China (Hernández-Fuentes *et al*., 2021). The fruits of the soursop tree weigh between 0.9 and 10 kg, these have an epidermis with carpel protrusion and fibrous pulp, usually with more than 100 seeds of 1 to 2 cm in length (Jiménez *et al*., 2014), they are also highly appreciated for their edible pulp, which has a soft and fibrous texture with a rich sweet and sour taste, in addition to having a high content of nutrients and bioactive compounds, due to this, the soursop fruit represents an option as food, since it can provide benefits to human health, in addition to having great potential for its industrialization and development of various food products (Villarreal-Fuentes *et al*., 2020).

According to records of the Agrifood and Fisheries Information Service (SIAP, for its acronym in Spanish), for 2019, 3 612.54 ha cultivated with soursop were reported in Mexico, with an average yield of 9.69 t ha^{-1} and a value of total production close to 248 million pesos; of the number of hectares nationwide, 2 456.94 ha have been reported in Nayarit, which represented 68%, distributed in the municipalities of Compostela (2 371 ha), San Blas (52.4 ha), Bahía de Banderas (15 ha), Tepic (12 ha) and Xalisco (6.54 ha) (SIAP, 2019).

In Mexico there is a great diversity of soursop genotypes, since most of the established plantations correspond to trees propagated by seed (Hernández *et al*., 2017), such is the case of Nayarit, where soursop plants are propagated sexually in orchards, so their fruits have diverse morphological characteristics, these variations can be used, through the selection and evaluation of materials that show comparative advantages and can subsequently be characterized, registered and released as varieties (Nolasco-González *et al*., 2019). These characteristics suggest a vast genetic resource, which can be used in research on the selection of superior genotypes through characterization, selection, use and conservation (Terán-Erazo *et al*., 2019).

In this regard, in Nayarit, research has been carried out at the morphological and physicochemical level of soursop fruits, the results of which have made it possible to make selections and registration of varieties (Guanay-1, Guanay-2 and Guanay-3) of which the Autonomous University of Nayarit obtained the breeder's right. The objective of this contribution is to share and disseminate the main morphological and physicochemical characteristics of three new varieties of Guanay-1, Guanay-2 and Guanay-3.

Origin of the varieties Guanay-1, Guanay-2 and Guanay-3

To obtain these varieties, 30 trees (10 per variety) that were vigorous, ungrafted and with visible absence of pests and diseases were selected in a commercial orchard in the locality of Venustiano Carranza (21° 32' 2.77" north latitude, 104° 58' 39.73" west longitude, 893 masl) of the municipality of Tepic, Nayarit. The study trees were 19 years old, their origin comes from genotypes of soursop established in orchards of the ejido Platanitos (21° 31' 24.25" north latitude, 104° 58' 27.37" west longitude, 1 075 masl) of the municipality of Tepic, Nayarit.

In 2016, a selection of the trees was carried out, considering the distinctive morphological characteristics of the fruits; subsequently it was monitored for two years, it was observed that the fruits of the selected trees retained the distinctive morphological characteristics of each variety, in

2018, the morphological and physicochemical characterization of the fruits (six fruits per tree of each variety) at maturity of consumption was carried out. As a basis for the characterization of the fruits, the descriptors of cherimoya (*Annona cherimola* Mill.) registered and proposed by the International Union for the Protection of New Varieties of Plants (UPOV, 2019) were used.

Titratable acidity was determined by the official method AOAC (2005), by volumetric titration with sodium hydroxide (NaOH) and phenolphthalein as an indicator, the results were expressed in percent citric acid. Firmness was assessed with a texture meter (Chatillon® MT 150 L) with a conical tip 6 mm in diameter of the base and 5 mm in length from the base of the cone to the apex. With the data obtained, an analysis of variance and comparison of means with Tukey's test ($p \leq 0.05$) were performed using the Statistical Analysis System (SAS® V. 9.2) software.

Description of varieties

The shape of the fruits of the variety Guanay-1 was heart-shaped with a round apex, the habit of the fruits was present in stems and branches, the weight was 1 438.79 g, the length of 17.09 cm, with a diameter of the cross section of 11.07 cm, the fruits had small stylar protuberances on the surface, which measured 0.5 mm in length (Figure 1A). The fruits of the variety Guanay-2 presented an irregular shape with a conical apex, the habit of the fruits was present both in stems and branches; they averaged a weight of 1 948.01 g, a length of 25.31 cm and a diameter of 13.17 cm, the protuberances presented by the fruits on the surface measured 2.05 mm in length (Figure 1B).

Figure 1. Soursop varieties Guanay-1 (A); Guanay-2 (B); and Guanay-3 (C).

The shape of the fruits of the variety Guanay-3 was conical with a round apex; the habit of the fruits was present in stems and branches, the weight of this variety was 902.27 g, with a length of 21.17 cm and a diameter of 10.96 cm, the protuberances present on the surface of this variety measured 7.56 mm in length (Figure 1C). The analysis of variance showed significant differences between varieties ($p \leq 0.05$). Generally, the shape of soursop fruits is described as oval-heart-shaped and some fruits have an irregular, asymmetrical curved shape due to inappropriate carpel development or voids produced by insects (Lawrence, 2007).

The weight and dimensions of the fruits are also varied and weights between 0.4 and 2 500 g, longitudinal diameters of 10 to 26 cm and equatorial diameters of 8 to 15 cm have been reported (Nolasco-González *et al*., 2019). The variability presented by the fruits of soursop, in their morphological characteristics, is due to the fact that they come from plants reproduced by seed, which leads to the fruits presenting high variation in shape and size (Terán-Erazo *et al*., 2019).

The fruits of the variety Guanay-1 had fewer seeds (86), greater firmness (24.62 N) and lower titratable acidity (0.62%), while the fruits of the variety Guanay-2 showed a higher number of seeds (166), high titratable acidity (0.96%) and lower firmness (7.82 N) with respect to Guanay-1. The variety Guanay-3 showed the largest number of seeds (231) and the largest protuberance size (7.5 mm) unlike the other two varieties, the titratable acidity and firmness was similar to the variety Guanay-2 (Figure 2 and 3).

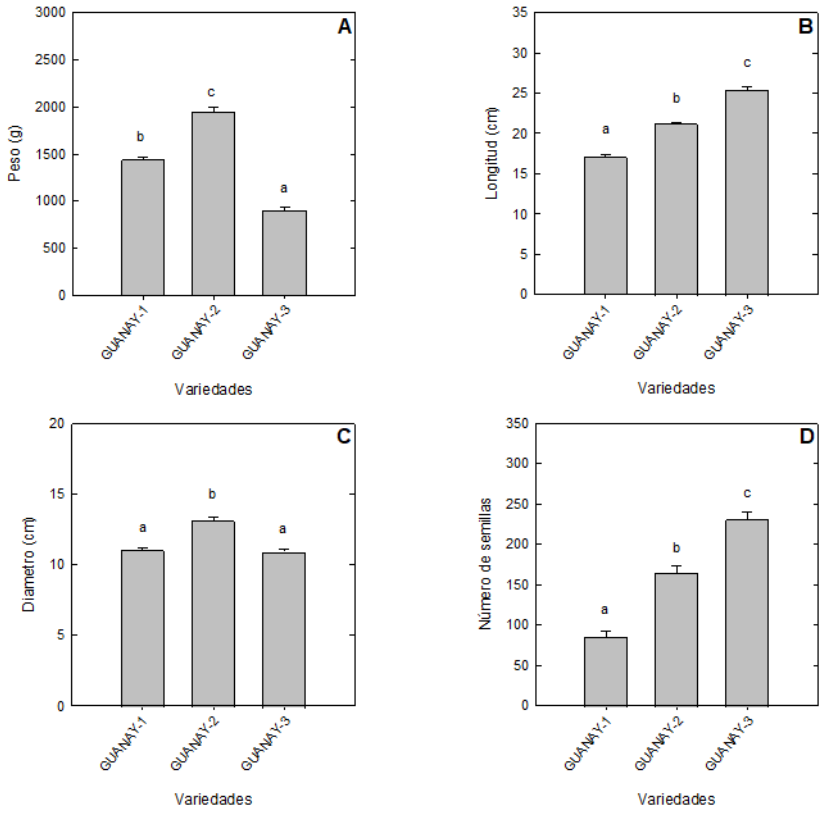

Figure 2. Weight (A); length (B); diameter (C); and seed number (D) of three soursop varieties (Guanay-1, Guanay-2 and Guanay-3). Each point represents the mean of 11 to 26 observations and its standard error. Different literals present significant differences ($p \leq 0.05$).

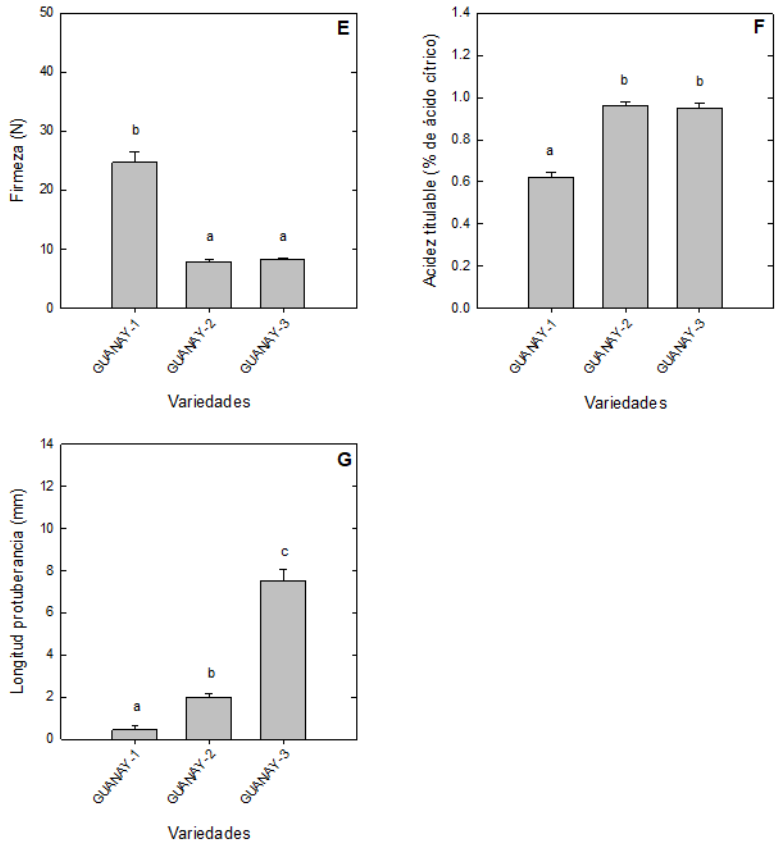

Figure 3. Firmness (E); titratable acidity (F); and protuberance length (G) of three soursop varieties (Guanay-1, Guanay-2 and Guanay-3). Each point represents the mean of 11 to 26 observations and its standard error. Different literals present significant differences ($p \leq 0.05$).

Statistically, there were significant differences ($p \leq 0.05$) between varieties. The number of seeds per fruit showed high variability since it has been reported that they can have more than 200 seeds and that this depends on the size of the fruit (Nolasco-González *et al*., 2019). Jiménez-Zurita *et al*. (2016) report a titratable acidity between 0.3 to 1.2%, for their part these same authors indicate values of 21.61 and 7.19 N in mature fruits, which coincide with the data of this research (0.62-0.96% citric acid) and (24.61 and 7.83 N) respectively.

Conclusions

Three soursop varieties, Guanay-1 (registration number GUN-OO1-020719), Guanay-2 (registration number GUN-OO2-020719) and Guanay-3 (registration number GUN-OO3-020719) were registered in the National Catalogue of Plant Varieties (CNVV, for its acronym in Spanish), whose main distinguishing characteristics were: size, shape, weight, number of seeds, titratable acidity and the size of the protuberances. Selection by morphological characteristics was an adequate method to register three varieties of soursop. The registration of varieties can contribute to the technological development of soursop cultivation in Nayarit.

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