Colegio de Postgraduados

Morphological description in wild grape fruits [*Ampelocissus acapulcensis* (Kunt) Planch]

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ABSTRACT

Objective: To perform the first morphological characterization of fruits and seeds of the wild grape, *Ampelocissus acapulcensis* (Kunt) Planch, collected in the Costa Chica region of Guerrero, México.

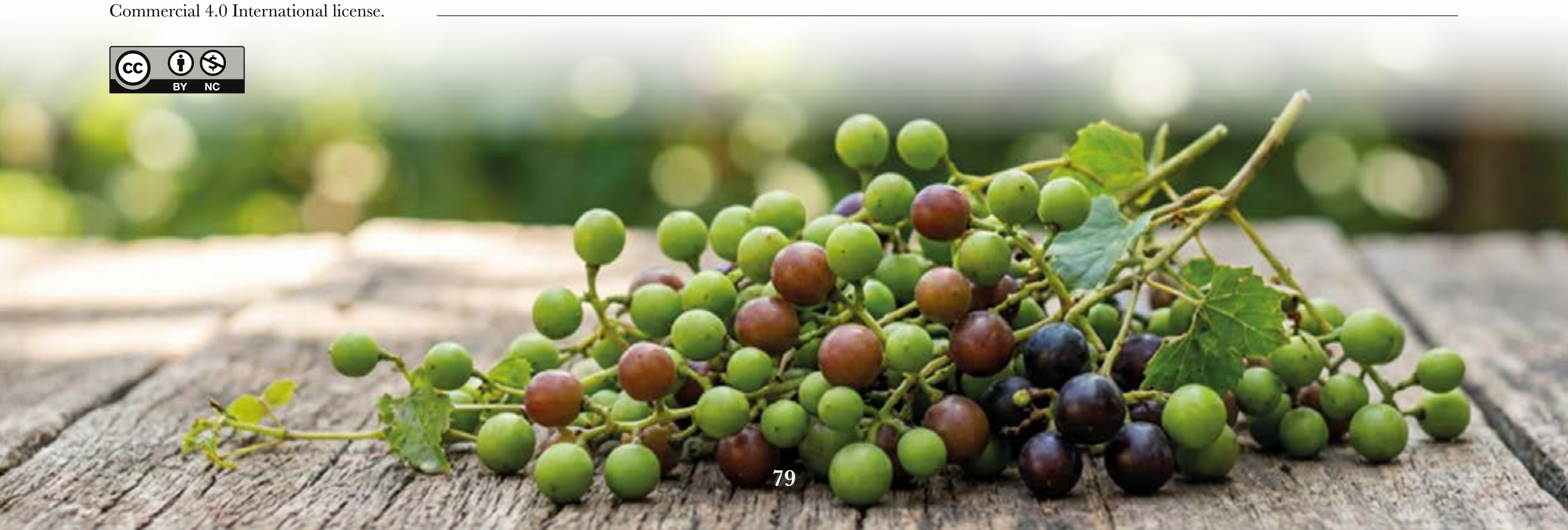
Design/Methodology/Approach: Fruits were collected, processed, and analyzed in the laboratory of the Universidad Autónoma de Guerrero. Evaluated variables included number of fruits per bunch, bunch weight, fruit weight, polar and equatorial diameters, shape index, fruit color, number of seeds per fruit, and seed traits (weight, diameter, and shape). Each morphological character was also documented photographically using a digital camera. Data analysis was conducted using SAS software, with central tendency statistics calculated for all measured traits.

Results: Individual fruits averaged 5.05 g in weight, with mean polar and equatorial diameters of 19.08 mm and 19.57 mm, respectively. Fruit shapes ranged from globose to round or elliptic. The epicarp exhibited a purple-red hue, while the pulp was translucent and viscous. Dry seeds weighed approximately 0.15 g, were heart-shaped and black in coloration, and each fruit contained between 1 and 4 seeds. On average, the fruit biomass was distributed as 12.93% epicarp, 74.35% mesocarp, and 12.72% endocarp.

Limitations and Implications: Although several vine species, including wild grape, occur in the tropical deciduous forest of the region, their fruits remain poorly studied. This lack of information limits potential applications for health, nutrition, and economic development.

Findings/Conclusions: The fruits of *A. acapulcensis* exhibit promising morphological quality, yet further research is required to fully explore their potential.

Keywords: *Ampelocissus acapulcensis*, *Vitis*, morphological qualities, field grape.



INTRODUCTION

Throughout history, grapes have held significant importance not only for fresh consumption, in juices, jams, or dried form, but also for winemaking (Robinson, 2006; Santander *et al.*, 2022; Rosas-Leyva *et al.*, 2023). The grapevine is considered a model plant, even cited in the Bible (Picornell & Melero, 2013). Although its exact origin remains uncertain (Galet, 1979), of the approximately 24,000 existing varieties, only 150 are cultivated for consumption (Robinson, 1986). Grapevines belong to the genus *Vitis*, within a family variably referred to as Vitaceae, Vitidaceae, or Ampelidaceae (Willis, 1973). Naturally thriving in Mediterranean climates, the grapevine is now predominantly distributed across Europe and Asia (Picornell & Melero, 2013; Rosas-Leyva *et al.*, 2023). It demonstrates notable drought tolerance (Aleixandre *et al.*, 2013) and can withstand adverse edaphoclimatic conditions. Grapes are globular berries covered by the skin or epicarp, which protects and shapes the fruit. The mesocarp, or pulp, is juicy and viscous, rich in must, and typically contains up to four seeds. Immature grapes contain chlorophyll, enabling the synthesis of nutrients that sustain them. Each grape comprises approximately 84% pulp, 7% skin, and 4% seeds (Hidalgo, 2002). According to Santander *et al.* (2022), grapes grown in cooler climates tend to exhibit higher acidity, whereas those from warmer regions are sweeter and more flavorful. The genus *Ampelocissus* includes wild grape species, encompassing 94 species primarily distributed across South America and tropical Africa, with only five found in Central America. These species are characterized by tendrils associated with the leaves and inflorescences (Galet, 1979; Chen & Manchester, 2007). Wild species are climbing lianas that, at the onset of the rainy season, produce vigorous shoots emerging from the ground and ascending to the upper branches of trees, ultimately bearing fruit. They behave like annual species, as their vines often become defoliated and perish frequently due to pasture burns (Zepeda & Velázquez, 1999). These authors also note that forests dominated by such climbers, alongside grasses and herbs, typically reflect ecological disturbance, as observed in the Costa Chica region of Guerrero and Oaxaca. *Ampelocissus acapulcensis* (Kunt) Planch. is native to Mexico, with its first record dating back to 1887. It is distributed from southwestern Mexico to El Salvador, thriving in tropical biomes and bearing fruit during the dry season. Commonly known as wild grape (*Ampelocissus acapulcensis*, synonym *Vitis acapulcensis*), or locally as "uva cimarrona" or "uva de campo" (CONABIO, 2022), it primarily grows in deciduous tropical forests. In Mexico, it is found along both the Pacific Ocean and Gulf of Mexico coasts. This species is a cylindrical liana with watery pubescence. Each node produces a large, slightly toothed, undivided leaf, a tendril, and a grape cluster. The fruits are sub-spherical berries measuring 1.2×1.3 cm, purple in color, and possess an astringent flavor (Santamarina *et al.*, 2004; Ibarra-Manríquez *et al.*, 2015; CONABIO, 2022). Each fruit contains one to four seeds, ranging from 4 to 12 mm in length (Chen & Manchester, 2007; Yeo *et al.*, 2013). The wild grape (*Vitis tiliifolia*) fruit consists of approximately 23% skin, 60.4% pulp, and 15.8% seeds (Rosas-Leyva *et al.*, 2023). It is worth noting that grapevines yield fruits of substantial commercial value. However, the agroindustry has largely overlooked wild grapes, which hold potential as raw material for artisanal wine production, nutraceutical beverages, or concentrates of bioactive compounds (Gallegos *et al.*, 2021), applicable in medicine or cosmetics, and potentially generating economic benefits for local producers in the regions where the plant grows naturally (Gaona *et al*., 2010; Porto *et al*., 2013; Juárez *et al*., 2017; Erice, 2021). To date, there are no scientific reports documenting the presence of this species in the Costa Chica region of Guerrero. Nonetheless, it grows annually in the area, producing fruit clusters and exhibiting resilience to the frequent fires common in the region. Documenting the presence of wild grape populations is therefore crucial to promoting conservation measures. This species may serve the industry or act as a rootstock for cultivated varieties, contributing to the preservation of genetic diversity and vigor, along with unique traits such as fruit coloration. Accordingly, the aim of this study was to conduct the first morphological characterization of fruits and seeds of wild grape (*Ampelocissus acapulcensis* (Kunt) Planch.) collected in the Costa Chica region of Guerrero, Mexico a species currently facing risk of extinction in this area.

MATERIALS AND METHODS

This research was conducted in the Costa Chica region of Guerrero, located in the Pacific zone of southwestern Mexico, which currently experiences both dry and rainy seasons. The surveyed area lies at an average altitude of 40 meters, with geographic coordinates of 16° 39' 21" N latitude and −98° 30' 2" W longitude (Nuestro-México, 2024). To collect wild grape (*Ampelocissus acapulcensis*) fruits, fieldwork was carried out from the municipality of Florencio Villarreal to Cuajinicuilapa. However, the specimens were ultimately found near San Juan de los Llanos, in Igualapa, Guerrero, Mexico. Clusters of grapes at full ripeness those in which all berries were pink or red were harvested. A total of 20 clusters were collected from different plants. Each cluster was placed in a transparent plastic bag, labeled, sealed, and transported in buckets to the Food Analysis Laboratory of the Regional Center for Higher Education of the Costa Chica, Cruz Grande Campus, of the Autonomous University of Guerrero. The fruits were washed with potable water, air-dried, and arranged on laboratory worktables. A Completely Randomized Design (CRD) was used to select four replicates, each consisting of five clusters. The sampling design considered both the morphological variability and geographic distribution of wild grapes in the Costa Chica region. The sample size was determined by the number of clusters available in the field. The evaluated variables included individual cluster weight, measured using an electro-analytical balance (Scientech ZSA120, Boulder®, USA), and the number of berries per cluster. Fruit color was determined using the Color Grab® digital application. For individual fruit evaluation, 20 berries were randomly selected from each cluster, resulting in four replicates of 100 fruits each. The following parameters were assessed: fruit and seed weight; polar diameter (measured from apex to base at the midsection) and equatorial diameter (measured transversely at the widest part of the fruit), using a Truper Stainless® Steel digital caliper. The shape index was calculated by dividing polar diameter by equatorial diameter. Additionally, the number of seeds per fruit and the pulp percentage relative to total fruit and seed weight were determined. Images were captured using a SONY digital camera (Optical SteadyShot®, 24.3 megapixels). Data obtained from the evaluated variables were analyzed using SAS® statistical software version 9.3 (SAS, 2011), employing central tendency measures.

RESULTS AND DISCUSSION

Wild grape fruits (*A. acapulcensis*) exhibited considerable morphological variability. Table 1 presents the central tendency statistics of the evaluated fruit and seed descriptors. This genotype develops similarly to commercial grapevines, with fruit clusters or infructescences arranged axially along the stem, accompanied by a leaf and a tendril that twines around the branches of other plants, providing structural support and enabling the plant to bear the weight of the fruit clusters. Each cluster contained between 10 and 68 fruits, with an average individual fruit weight of 5.03 g. Bascam and Ozcan (2022) evaluated the morphological characteristics of grape varieties and reported that Antep Karası and Trakya İlkeren exhibited similar fruit weights, indicating their suitability for both fresh consumption and processing due to their average size. In contrast, varieties such as Crimson Seedless and Red Globe produce fruits weighing 2.74 g and 12.80 g, respectively, representing both smaller and larger extremes compared to the present study. Abiri *et al.* (2020) also reported grape fruits classified as germplasm collections with higher values, likely due to breeding and advanced agronomic practices applied to cultivated varieties. Fruit lengths (polar diameters) ranged from 14.33 to 21.83 mm, while equatorial diameters varied from 14.26 mm (smallest) to 23.09 mm (largest). Notably, the polar and equatorial diameters showed minimal differences: a minimum of 0.07

Table 1. Morphological Characteristics of Fruits and Seeds of Wild Grape (*Ampelocissus acapulcensis* (Kunt) Planch).

Variable	Minimum	Maximum	Mean	CV (%)	SE
Fruit					
Number of berries per cluster	18	68	45	34.71	15.62
Individual fruit weight (g)	1.90	7.76	5.03	30.27	1.52
Polar diameter (mm)	14.33	21.83	19.08	10.62	2.03
Equatorial diameter (mm)	14.26	23.09	19.57	12.39	2.42
Shape index	0.89	1.02	0.98	3.72	0.04
Skin weight (g)	0.36	0.76	0.65	19.44	0.13
Pulp weight (g)	1.29	5.95	3.74	31.85	1.19
Number of seeds per fruit	1	4	2.44	42.29	1.03
Skin color	-				
Pulp color	-				
Seeds					
Fresh seed weight per fruit (g)	0.14	1.07	0.64	39.91	0.26
Individual fresh seed weight (g)	0.14	0.30	0.27	14.58	0.04
Individual dry seed weight (g)	0.14	0.17	0.15	7.05	0.01
Polar diameter (mm)	9.06	9.92	9.61	2.86	0.28
Equatorial diameter (mm)	7.09	8.10	7.57	4.12	0.31
Thickness (mm)	4.86	5.81	5.34	5.18	0.28
Shape index	1.12	1.37	1.27	5.10	0.06
Seed color	-				

Note: N=300 fruits; CV=Coefficient of Variation; SE=Standard Error.

mm, a maximum of 1.26 mm, and an average of 0.49 mm. From these morphological parameters, the shape index was calculated, classifying the fruits as slightly elongated, ellipsoid, or round. Other studies on various grape species reported similar polar and equatorial diameter values (Kupe *et al.*, 2021), supporting the productive potential of this wild grape genotype in the studied region. Abiri *et al.* (2020) recorded polar diameters ranging from 12.32 to 31.85 mm in different grape accessions. The wild grape fruits in this study fall within the average of those values. Other studies on varieties such as Antep Karası and Michael Paliere reported polar diameters of 22.28 mm and 22.40 mm, respectively similar to those found in this investigation. However, equatorial diameters in those studies were closer to the minimum values observed here, indicating more oval or elongated fruit shapes.

This differs from the round or ellipsoid shapes found in the present study (Bascam & Ozcan, 2022). It is worth noting that those previous studies were based on fruits from established grapevine cultivars intended for table grape or wine production. Additionally, Franco and Cruz (2012) studied wild grapevines in Mexico and found fruits with shapes similar to those in this study. While some reports highlight varied fruit shapes in grape species, the majority consistent with this research are spherical (Kupe *et al.*, 2021). Furthermore, Cáceres *et al.* (2017) studied eight grape varieties intended for pisco production and reported that only the Italia variety exhibited a larger polar diameter (23 mm). For equatorial diameter, however, all varieties showed smaller sizes compared to the wild grape. These findings suggest that those varieties tend to have oval shapes, contrasting with the round or ellipsoid shapes observed in this research (Cervantes & Martín, 2019).

Mature fruits displayed a reddish-purple skin and a white, viscous, and translucent mesocarp. The coloration of grape berries varies depending on the variety; for instance, Red Globe and Crimson Seedless exhibit hues similar to those observed in this study (Bascam & Ozcan, 2022). The skin is notably firm, with a waxy and consistent outer layer that is easily separable from the pulp, weighing an average of 0.65 g. The mesocarp, or pulp separated from both the seeds and the epicarp ranged from 1.29 g to 5.95 g in weight for the smallest and largest fruits, respectively. Each fruit contained at least one fully developed seed, with a maximum of four, averaging 2.44 seeds per fruit. Bascam and Ozcan (2022) reported similar results, noting both seedless grape varieties and others bearing three to four seeds per fruit, with Antep Karası being the only variety that matched the present study's average of 2.5 seeds per fruit.

The total fresh seed weight per fruit was 0.64 g, with individual fresh seed weights ranging from 0.14 g to 0.30 g. Dry weights ranged between 0.14 g and 0.17 g. According to Aguirre (2011), Vitis fruits found in southern Mexico averaged 2.6 seeds per fruit with seed weights between 0.02 g and 0.05 g significantly smaller than those observed in the current study. The seeds exhibited a hawk-beak or heart-like shape, with an average polar diameter of 9.61 mm and equatorial diameter of 7.57 mm, indicating an elongated form, and an average thickness of 5.34 mm. Chen and Manchester (2007) described grape seeds as pyriform or oval, with each fruit typically containing one to four seeds most commonly two or three. They also noted that when only one seed develops, it tends to be larger than when four are present, with an average seed length ranging from 4 to 12 mm. These values are consistent with the seed sizes observed in this study. Comeaux (1987, 1991) and Franco & Cruz (2012) evaluated seeds of *V. jaegeriana*, *V. bloodworthiana*, and *V. vesbittiana*, all of which displayed lower measurements than those reported here. This variation may be attributed to species differences or levels of domestication, as the fruits evaluated in this study are entirely wild, with no previous documentation available. Other studies evaluating seed length across various *Vitis* species also reported smaller values than those found in this work (Martín-Gómez *et al.*, 2020), although the seed shape elongated or pyriform was consistent (Cunha *et al.*, 2007). Seed color was uniformly black. Figure 1 illustrates the *A. acapulcensis* wild grape fruits: Figure 1a shows a complete cluster; Figures 1b and 1c display individual fruits in horizontal and vertical orientation, respectively, highlighting two pedicel attachment points. Figure 1d presents the separated mesocarp and endocarp from the whole fruit, exposing the seeds embedded in the juicy, viscous pulp (Figure 1e). Fresh seeds, covered in mucilage and featuring a prominent horizontal groove, are shown in Figure 1f.

A. acapulcensis is a genotype exhibiting notable morphological quality. Based on the reported fresh weights of the epicarp, mesocarp, and endocarp, the proportional composition of each fruit component was determined: 12.93% skin, 74.35% pulp, and 12.72% seeds. These findings align with values reported by Rubio (2011), who described grape berries as fleshy fruits composed of pericarp and seeds, with the epicarp accounting for 5-12% of total fruit weight, pulp for 64-90%, and seeds for approximately 10%. The present study, however, recorded a higher seed percentage. Finally, Vidaña-Rodríguez (1996) noted that in the Mixteca region of Puebla, the *Ampelocissus* genus is considered highly valuable; yet, existing studies primarily offer basic information on the *Vitis* genus, with minimal data available for the genotype analyzed in this research (Franco & Cruz, 2012).

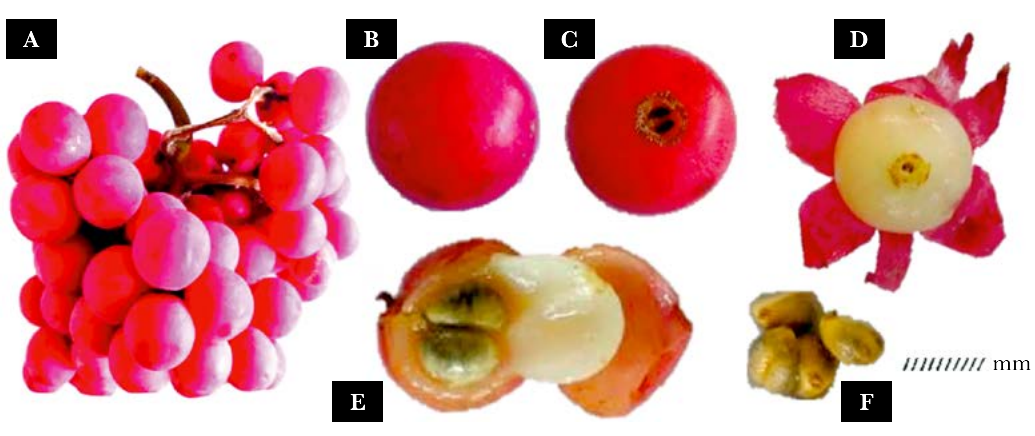


Figure 1. A) Cluster of wild grapes (*Ampelocissus acapulcensis* (Kunt) Planch.), B) whole fruit displayed vertically, C) fruit shown horizontally highlighting the peduncular area, D) separated pulp and epicarp of a whole fruit, E) longitudinally cut fruit exposing seeds, mesocarp, and endocarp, and F) seeds.

CONCLUSIONS

The wild grape of the Costa Chica region represents a valuable genetic resource that should be conserved and utilized as a foundation for crop improvement. The fruits weighed an average of 5.05 g and measured 19.08 mm and 19.57 mm in polar and equatorial diameter, respectively, resulting in a globose, round to ellipsoid shape, with a reddish-purple coloration. The dry seeds weighed 0.15 g, displayed a hawk-beak or heart-like shape, and were black in color, with each fruit containing one to four seeds. The pulp comprised 74.35% of the total fruit weight.

Further agronomic research is recommended to develop a production system for wild grape, establish cultivation practices for domestication, and enable the creation, innovation, and technological advancement of this species. Studying the bioactive compounds present in these fruits will support their integration into the agroindustry, allowing for the development of products that enhance population health and quality of life.

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