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CASE STUDY

## Wines of Fire and Earth: Exploring the Volcanic Terroirs of the Canary Islands – a Case Study

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**Abstract** – The Canary Islands, an Atlantic archipelago of volcanic origin, offer an extraordinary case study of the interplay between geology and viticulture. Forged by millennia of hotspot volcanism, these islands boast dramatic landscapes characterized by volcanic soils (picón), microclimatic diversity, and ecological richness. This unique confluence of natural factors has not only shaped the environment but also defined the character and identity of the region’s wines. This article delves into the volcanic terroirs of the Canary Islands, with a particular focus on the iconic regions of Lanzarote and Tenerife. Through a multidisciplinary approach encompassing geology, viticulture, and oenology, we aim to unravel the complexities of these volcanic vineyards. We explore how the islands’ geological legacy and microclimatic nuances influence vine cultivation practices, enhance the organoleptic properties of the wines, and contribute to a viticultural identity that is as distinctive as it is resilient. From Lanzarote’s La Geria, where traditional practices transform volcanic ash fields into strikingly innovative vineyards, to Tenerife’s ancient grape varieties thriving on terraced slopes, the Canary Islands demonstrate a remarkable synergy between human ingenuity and natural beauty. These vineyards, integral to the Canarian landscape, are a testament to the enduring relationship between cultural heritage and ecological sustainability. In this study, we examine the challenges and opportunities facing this viticultural heritage, while offering insights into its potential for innovation and sustainability in an evolving global wine market. The region’s success is presented as a blueprint for sustainability in the face of global climate change through maintaining high-quality, distinctive wines applying organic and biodynamic methods. The most important scientific contribution of this case study is the holistic, ecosystem-centred analysis of this unique viticulture in terms of ungrafted vine cultivation, the significant genebank potential of the ancient grape varieties, the possibilities of developing organic circular bioeconomy-based viticultural practices in extreme wine terroirs, and the mitigation of the adverse impacts of climate change. Furthermore, by bridging ecological, agricultural, oenological, and economic perspectives, the profound impact of isolated volcanic terroirs on the Canary Islands’ viticulture and winemaking and their unique contributions to the broader world of viticulture is presented.

**Keywords** – organic viticulture, endemic grape varieties, ungrafted vines, hoyos system, agroecology, climate change, wine tourism, cultural heritage conservation, sustainability

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### INTRODUCTION

To understand the uniqueness of viticulture and winemaking in the Canary Islands, we need to become familiar with some of the basic elements of their geology. The geological development of the Canary Islands is primarily the result of intraplate hotspot volcanism over the last 20 million years (Zaczek et al. 2015). Situated on the African tectonic plate, the archipelago formed as the plate moved slowly over a stationary mantle plume (hotspot), creating a chain of progressively younger islands toward the west (Fig 1A, B).

Unlike the Hawaiian Islands, the Canary Islands do not undergo significant subsidence; instead, they remain emerged

until reduced by erosion or landslides. The Canary Islands’ geological landscape is defined by five primary features:

1. Shield Volcanoes are massive, low-profile structures that form the geological foundation of the archipelago called “Old Edifices”. They have broad, gentle slopes (convex shape) built from repeated eruptions of low-viscosity basaltic lava that flow long distances before solidifying. Key examples include the Anaga and Teno massifs on Tenerife (Fig. 1 C) and the entirety of La Gomera.
2. Stratovolcanoes are steeper, explosive composite peaks found on central islands. Mount Teide on Tenerife is the most prominent, rising 3,718 m above sea level (Fig 1. C). When measured from its base on the ocean floor

(reaching a total height of approximately 7,500 metres), it is considered the third-tallest volcanic structure on Earth. Teide is a complex of several volcanoes that rise within a 16-km-wide caldera known as Las Cañadas (Fig. 1C). Since 2007, the surrounding Teide National Park has been a UNESCO World Heritage Site, recognized for its global geological importance and diverse volcanic landscapes.

3. Collapse Calderas: Massive depressions created by volcanic collapse or erosion, such as the above-mentioned Las Cañadas Caldera in Tenerife (Fig. 1 C) and the Caldera de Taburiente in La Palma.
4. Rift Zones: Triangular or Y-shaped systems that channel magma to form aligned cones and fissures. The Cumbre Vieja on La Palma is the archipelago’s most active rift
5. Lava Fields: Vast areas of relatively young volcanic rock resulting from recent activity, such as the 2021 Tajogaite eruption.

creating cloud banks between 600 m and 1,800 m. This provides necessary moisture and cooler temperatures for high-altitude vineyards. The combination of volcanic soils, diverse microclimates, and isolation from the phylloxera plague makes this one of the world’s most unique and “heroic” wine regions. The diverse lithology — including basalts, trachytes, and phonolites — results in mineral-rich, light, porous, and well-draining soils, which prevents waterlogging and promotes deep root systems. Recent research on the mineral content of monovarietal red wines from the Canary Islands confirmed, that the mineral content of wines could be utilised to classify red wines by origin (Heras-Roger et al. 2024). The abundance of iron and potassium in the soil can impart a “salty sweetness” to the wines, and sulphur in the soil can contribute savoury notes. The dark, porous volcanic ash (known as picón or lapilli in Lanzarote) has an extraordinary capacity to retain hygroscopic moisture from the air and subsoil, allowing vines to survive in the arid climate. The sandy and volcanic soils and the islands’ isolation from the mainland have prevented

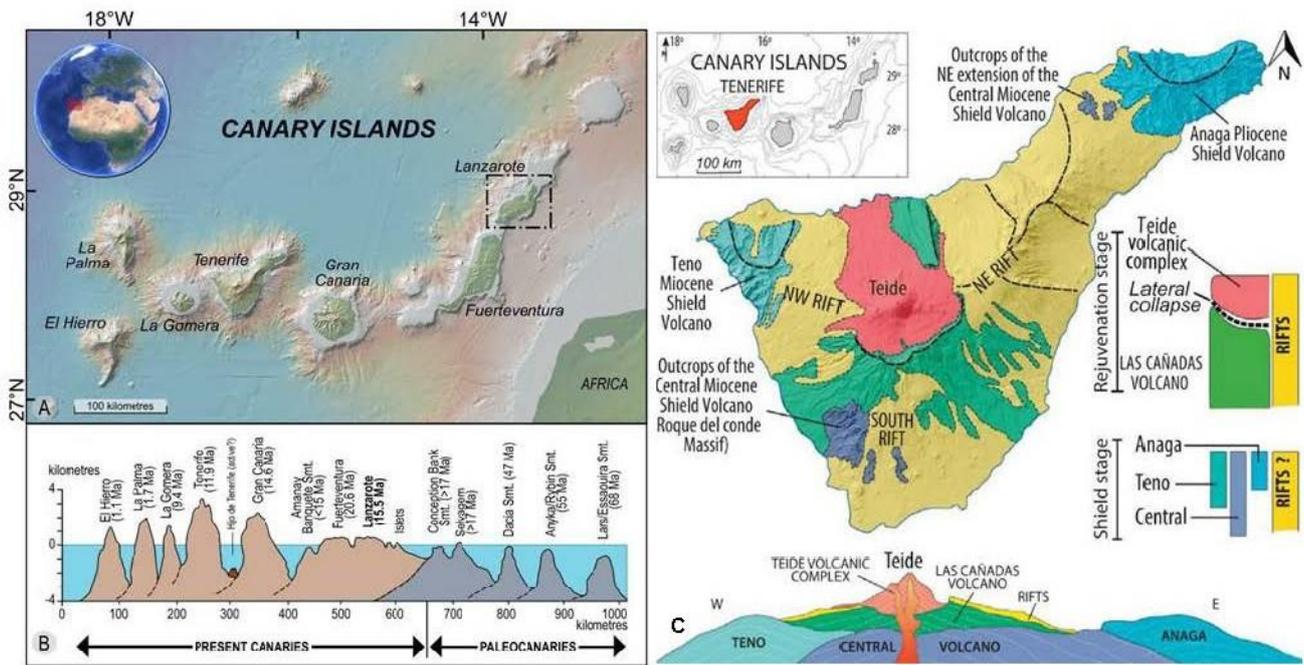


Figure 1. The geographic location (A) and the formation of the island chain and the associated seamounts of the Canary Volcanic Islands Province (B) where the ages decrease toward the southwest as the plate moves over the hotspot. The Island of Tenerife (C) is the geologically most diverse member of the Canary Archipelago. Here the key geological features are shown such as the shield volcanoes Anaga from Pliocene, Teno from Miocene, the Teide stratovolcano complex inside the vast caldera of Las Cañadas volcano, outcrops of the Central Miocene shield volcano and the complex network of rifts.

Source: assembled from Tomasi et al. 2023 <https://doi.org/10.1080/17445647.2023.2187717> and Leyva et al. 2021 <https://doi.org/10.1007/s00603-021-02762-y>

*Unique wine terroirs*

The unique geology, geomorphology, and climate of the Canary Islands create exceptional and extreme wine terroirs, where the vineyards range from near sea level to altitudes of nearly 1,700 meters, allowing different grape varieties to thrive in specific climate layers and contributing to a balance of acidity in the grapes despite the warm daytime sun. The islands’ steep orography forces moist trade winds upward,

the spread of the phylloxera louse (*Daktulosphaira vitifoliae*), meaning many vines are centuries-old and ungrafted, preserving ancient grape varieties (Agnolletti et al. 2023; Kreidlmayer, 2024). The challenging geography necessitates unique, labour-intensive farming methods, such as hoyos (pits) in Lanzarote, where the vines are planted in shallow, funnel-shaped pits in the volcanic ash, with semi-circular stone walls (zocos) built around them for protection from strong trade winds, or the unique and traditional Cordon

Trenzado (braided cord) system of vine cultivation in Tenerife, found primarily in the Orotava Valley, an ancient, handcrafted method that cannot be mechanized, well adapted to the local conditions, and manual harvesting (Rodríguez et al, 2025).

#### *Sustainability and organic viticulture*

Organic viticulture in the Canary Islands combines ancient, pre-phylloxera traditions with modern sustainability. The archipelago's volcanic terroir, high-altitude vineyards, and unique cultivation methods provide a naturally resilient environment for organic wine production. In the Canary Islands, organic viticulture relies on traditional adaptive techniques designed to manage extreme volcanic landscapes and increasingly frequent climate stressors like drought and high temperatures. Canarian viticulture utilizes unique training systems, canopy management and cultivation methods that naturally adapt the vines to their specific microclimates without synthetic inputs:

- **Geria (Lanzarote):** In these systems, vines are planted in naturally formed deep fissures (chabocos) or depressions (hoyos) excavated into volcanic tephra (rofe) and sheltered by semi-circular walls (zocos). This technique protects the vines from drying trade winds and allows the porous volcanic rock to capture nighttime humidity, effectively providing a natural irrigation system in an arid environment.
- **cordón Trenzado (Tenerife):** This “braided cord” system allows for long, flexible vine arms that can be moved or adjusted. Found primarily in Tenerife's Orotava Valley, vines are braided into long ropes that can reach 15 meters, allowing for natural ventilation and shared land use.
- **Regenerative Practices:** Modern organic wineries use natural fertilizers (compost, manure) and maintain biodiversity by integrating local livestock, such as goats and sheep, for weed control.
- **Organic practitioners in the archipelago focus on enhancing soil health to improve vine resilience:**
  - **Volcanic Tephra Mulching:** Layers of volcanic ash (lapilli) act as a natural mulch that inhibits soil evaporation and regulates ground temperature, vital for maintaining moisture in organic systems without supplemental irrigation.
  - **Green Manures and Organic Amendments:** Organic farms utilize inter-row herbaceous cover—such as mixtures of oats, fava beans (*Vicia faba*), lentils (*Lens culinaris*), Canarian clover (*Bituminaria bituminosa*), bitter vetch (*Vicia ervilia*), common vetch (*Vicia sativa*), cowpea (*Vigna unguiculata*), chickpeas (*Cicer canariense*), teide broom (*Spartocytisus supranubius*) and mustard (*Sinapis alba* or *Brassica juncea*) — to fix nitrogen, prevent erosion, enhance aeration and water infiltration, improve soil microbial diversity and weed suppression. In traditional areas, composted local manure (sheep or goat) is applied periodically to

maintain nutrient balance (especially Mg, Fe, and Mn) critical for volcanic terroir.

Conservation of biodiversity and adapting viticultural practices to mitigate the impacts of climate change:

- **Ungrafted (Pie Franco) Vines:** Due to the absence of phylloxera, Canary vines are ungrafted. While they are not inherently “more tolerant” of fungi due to being ungrafted, the islands' unique environment provides several natural advantages that limit fungal growth such as Atlantic trade winds, providing excellent ventilation, which naturally reduces the risk of fungal infections like mildew that thrive in humid, stagnant air or the porous volcanic soil that offers exceptional drainage, preventing waterlogging and reducing the likelihood of root rot and other moisture-related pathogens.
- **Canopy Management:** To combat rising temperatures, techniques such as late winter pruning and apical leaf removal are used to delay ripening. This helps maintain acidity and prevents excessive sugar accumulation, which is a common challenge in organic warm-climate viticulture (Vercesi et al. 2024).
- **Biodiversity Support:** Organic vineyards in the region intentionally maintain semi-natural vegetation and stone walls, which foster bird communities that act as natural pest control for insects like the grapevine moth.

Organic viticulture in the Canary Islands is a niche but expanding sector, characterized by unique environmental conditions that favour ecological farming. As of 2025, the archipelago maintains a total vineyard area of approximately 6,192 to 6,757 hectares. Tenerife is the largest wine-producing island, accounting for roughly 65% of all vines in the archipelago. Tenerife is a leader in organic practices; historically, it has represented more than 57% of all organic farming in the Canary Islands (Castillo et al. 2025).

The Tacoronte-Acentejo DO region alone represents 20% of the total viticultural area in the Canary Islands and is a hub for environmental impact studies and sustainable production.

The total cultivated vineyard area in Lanzarote is approximately 1,900 to 2,000 hectares. The island is becoming a benchmark for sustainability, with major wineries like El Grifo recognized for their commitment to sustainable and forward-looking viticulture, often supported by sustainable wine tourism (Cruz-Ruiz et al. 2023).

Despite the organic growth, the total vineyard area has faced a long-term decline (down roughly 30% since 2012) due to a lack of generational renewal and recent extreme droughts in 2023 and 2024 (OIV, 2024).

Canary Islands' viticulture and terroirs offer a unique contribution to vine and wine science through a combination of geological rarity, ancient genetic preservation, and innovative agroecological practices, based on circular bioeconomy. The islands preserve some of the world's oldest European vines, grown on their own roots rather than being grafted onto American rootstocks. The region hosts over 80 grape varieties, unique cultivars, including 25 that are

exclusive to the islands, such as Malvasía Volcánica. The viticultural framework in the islands integrates traditional knowledge with modern sustainability goals. Recent 2024 and 2025 studies focus on life cycle assessments and organic vs. conventional management to enhance the environmental value of the region's 11 Denominations of Origin (Castillo et al. 2025).

## RESEARCH FRAMEWORK AND METHODOLOGY

This case study is based both on site visits and extensive literature studies focusing primarily on the intersection of volcanic agroecology, technological resilience in viticulture in view of climate change, genetic conservation of indigenous grape varieties and protection of viticultural landscapes. This unique “heroic viticulture” region, defined by extreme growing conditions on small islands, serves as a *global model* for adapting to climate change. Very important is the water-energy nexus, the interdependence of water management and agriculture on volcanic islands, focusing on the vulnerability of aquifers to climate stress. Considering the unique topography and soil properties the “closed sustainable cycle,” utilizing onsite composting and green waste processing at high altitudes (often above 1,000 m) is presented through good practices adopted at wineries such as Bodegas Ferrera (Tenerife). The growing interest in adopting sustainable, organic, biodynamic or often permaculture-oriented practices is emphasized.

The integration of traditional viticulture with AI and modern technology reveals critical knowledge gaps alongside pioneering “good practices” from regions like the Canary Islands (Moganapathi et al. 2025). There is a critical shortage in the intergenerational transfer of “heroic” viticulture expertise, such as the manual maintenance of free-standing twisted vines or unique pruning methods. AI models struggle to integrate traditional, qualitative agronomic knowledge with quantitative, high-resolution sensor data, often leading to models that lack “terroir-specific” precision (Izquierdo-Bueno et al. 2024). Furthermore, most AI initiatives focus on isolated segments (e.g., irrigation) rather than creating a continuous data loop from the ancient vineyard practices to the final consumer (Sidorkiewicz et al. 2025). Literature lacks analysis on methods that effectively combine ancient techniques (like dry farming, braided cordon system) with unrelated new knowledge (like controlled deficit irrigation (DI), AI-driven predictive modelling) without compromising the authenticity of the tradition, although initiatives were taken to identify the main digital trends in the vine and wine sector (Boiling, C. 2025; OIV 2025).

The most important feature of the methodology in this case study is the holistic ecosystem approach of integrated vine and wine science embracing the geological development and geomorphology, soil properties, climate and microclimate systems, sustainable viticultural practices, the unique grape varieties as genetic resources (gene bank potential), the heritage and socio-economic value of the region enhanced by sustainable wine tourism, and strategic governance and future challenges. Wine tourism (oenotourism), when takes into consideration the carrying capacity of destinations, is a key factor for ecological, economic and social sustainability,

since it serves as a tool for economic diversification and rural revitalization, combating depopulation in areas such as Buenavista del Norte, Tenerife (Dorta Rodríguez et al. 2025).

## GRAPE VARIETIES OF THE CANARY ISLANDS

The wine regions of the Canary Islands represent a singular, “heroic” viticultural landscape defined by extreme climatic conditions, isolation, and a deep, historically significant cultural heritage. Until recently, the Canary Islands were one of the few places worldwide that remained entirely free from the 19<sup>th</sup>-century phylloxera (*Daktulosphaira vitifoliae*) plague that devastated European vineyards. Because they were never infested, vines are planted on their own roots without needing North American rootstock grafting. This often leads to a longer lifespan, with many vines exceeding 100 to 125 years of age. However, in August 2025, phylloxera was confirmed in specific areas of Tenerife for the first time. Local authorities have since implemented strict quarantine zones and bans on moving plant material between islands to protect the remaining heritage. Knowledge of grape varieties in the Canary Islands is essential, since the islands serve as a “garden of varieties,” preserving more than 80 different grape types, at least 14 of which are considered endemic and some of these grapes are extinct elsewhere in the world. A 2019–2024 molecular study proposed that 14 varieties and 3 sports (genetic mutations) are strictly local to the Canary Islands, meaning their genetic profiles are unique in the world (Marshal et al. 2019; Fort et al. 2023). Recent genetic studies on La Gomera (Fort et al. 2024) and La Palma (Lin-Yang et al. 2025) identified new, highly specific varieties such as *Malvasia periquin gomerae* and *Verdello gomerae* and *Forastera Gomera (Forastera Blanca Junoniense)*. Here the main white and red grape varieties are described, the most important (i.e. not only the most widely cultivated) ones more in detail with particular emphasis on origin, genetics, ampelography, ecology (sustainability and organic practices), cultivation, terroir requirements, climate hardiness, disease susceptibility, and wine quality.

### Key White Varieties

**Albillo Criollo** is a scarcely grown variety found mainly on Gran Canaria and La Palma, a native variety distinct from mainland Spanish Albillo varieties (Fig. 2).

For a long time, Albillo Criollo was often confused with other “Albillo” varieties from mainland Spain (like Albillo Mayor or Albillo Real). This variety is a perfect example of how DNA profiling has cleared up years of “varietal confusion” in the Canary Islands and beyond. DNA profiling identifies it as a cross between the Canarian Listán Blanco (Palomino Fino) and the Portuguese Verdelho. It is noted for being quite tolerant to common plagues and diseases. It produces medium-sized, compact grape clusters, the green-yellow-coloured berries are elliptical in shape. The fruit has medium-thick skin and firm flesh. Thrives in high-altitude vineyards (e.g., 850-1000 m) on volcanic soils, where day-night temperature contrasts slow maturation, enhancing quality. It is an early-ripening variety with a shorter growing season than Listán Blanco, allowing for earlier harvests, producing textured, fresh wines with a saline finish.

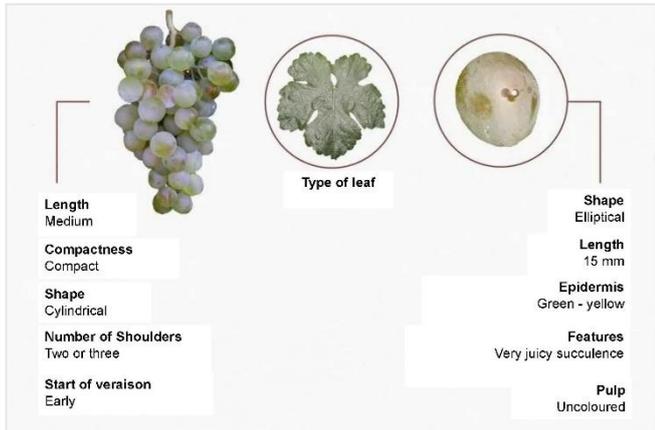


Figure 2. Albillo Criollo, planted mainly in the islands of La Palma, Tenerife and Gran Canaria. Source:

<https://dovalleorotava.com/en/grape-varieties/>

**Gual** (known as Bual in Madeira) is a white grape variety (Fig. 3) with high aromatic complexity that was introduced to the Canary Islands by the Portuguese in the 16<sup>th</sup> century. It is characterized as an early-ripening variety that produces medium-sized bunches. It has a semi-drooping growth habit; its mature leaves are characterized as small with marked lobes. It is typically cultivated at lower altitudes, often below 300 meters, to ensure it reaches its aromatic potential. Often trained using traditional methods like parral bajo (low trellis) or modern espaldera (vertical shoot positioning).

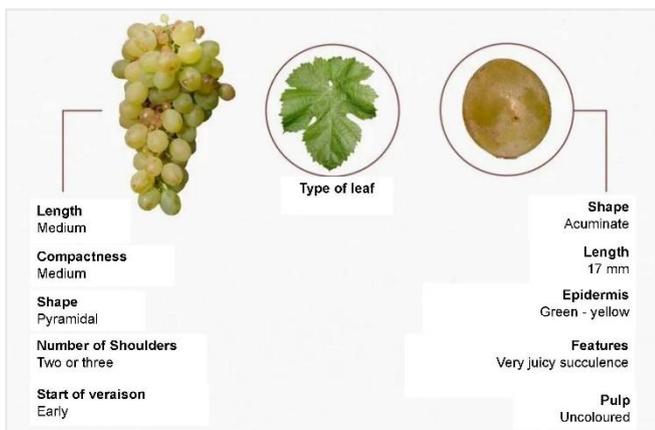


Figure 3. Gual, also known as Bual in Madeira, is an early ripening variety, grown on Tenerife, El Hierro and La Palma. Source:

<https://dovalleorotava.com/en/grape-varieties/>

Key growing regions include Tenerife (specifically the Ycoden-Deute-Isora area), El Hierro, and La Palma. It also has a tendency toward coulure (shattering of the flowers or small berries).

The grapes are highly aromatic with naturally high acidity and a high concentration of resveratrol. Gual is notoriously sensitive to fungal pathogens like botrytis (gray mold) and powdery mildew. When these fungi attack the grape skins, the vine triggers a metabolic “alarm,” producing stilbenes like resveratrol to inhibit the fungal growth. Wines made from Gual are known for their creamy texture and complex aromas

of tropical fruits (pineapple), jasmine, honey, and a distinct smoky minerality derived from volcanic soils.

**Listán Blanco** (Palomino Fino) is the most planted, highly adaptable, disease-tolerant grape, originally from Jerez de la Frontera in southern Andalusia, Spain, where it is the primary grape for Sherry production (Fig. 4). It is genetically identical to Palomino Fino. While it has numerous synonyms (over 130), DNA analysis confirms its unique identity as distinct from varieties like Sémillon or Albillo. This vine was introduced by Spanish settlers, it has adapted over five centuries in the islands’ unique, phylloxera-free environment, allowing for ancient ungrafted (pie franco) vines. The vine displays high vigour and a semi-upright growth habit with long, trifurcated tendrils. The leaves are large, adult leaves typically have five lobes with deep lateral sinuses and a blistered leaf blade. The grape clusters are large, long, cylindrical, and relatively loose (not very compact), often wide at the shoulders; the berries are medium to large, round (sometimes ovoid) shape with thin, green-gold or yellow skin when ripe.

It is highly tolerant to powdery mildew and downy mildew, which facilitated its widespread adoption across diverse microclimates (Sancho-Galán et al. 2020). However, the variety is highly sensitive to Botrytis (bunch rot) and therefore late rains can be particularly damaging. It is also susceptible to wind breakage and browning/oxidation. Noted for excellent resistance to drought and heatstroke, essential for the arid volcanic regions of the Canary Islands. Shows its best expression at altitudes above 600 metres, reaching over 1,000 meters in some areas. Requires short pruning (due to high productivity and vigour) and often shoot-tying to prevent wind damage.



Figure 4. Listán Blanco, one of the most widespread varieties of the Canary Islands.

Source: <https://dovalleorotava.com/en/grape-varieties/>

It is an early to mid-season ripening variety. Because acidity drops sharply at maturity, precise harvest timing is critical for table wine production. It produces fruity, citrusy, and floral wines.

**Malvasía Aromática** is a historic white grape variety fundamental to Canary Islands viticulture, especially on La Palma and Tenerife (Fig. 5). It is distinct from the more common Malvasía Volcánica (Malvasía de Lanzarote) but

genetically identical to the Croatian Malvasia Dubrovacka and the Catalan Malvasia de Sitges (Rodríguez-Torres et al. 2009). The variety has a generally low vigour with short internodes and a semi-erect growth habit and a well distinguishable morphology. Young shoot tips are open with sparse hairs and strong anthocyanin (reddish) coloration. Mature leaves are small, pentagonal, and deeply divided into seven lobes with large convex teeth. Clusters are medium to long with medium firmness. Berries are medium to large, elliptical, and turn a distinctive green-yellow (sometimes reddish yellow) when ripe. Often grown on small, traditional plots, in La Palma, it is frequently found in steep, terraced vineyards.

Regarding abiotic stress, the variety is sensitive to spring frosts but has good drought resistance and thrives in hot, sunny climates. It has low resistance to major fungal diseases, being particularly sensitive to Oidium (powdery mildew) and Bunch Rot (*Botrytis*). The wines are characterised by highly terpenoid profile with powerful notes of apricot, peach, white currants, grapefruit, and honey; high aromatic potential combined with high natural acidity and high alcohol content (often reaching 14% vol). Sweet versions can age exceptionally well. Historically famous for the sweet “Malmsey” wines favoured by European royalty.

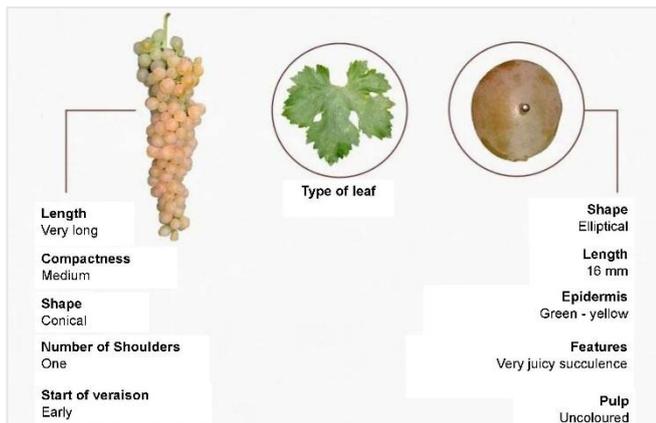


Figure 5. Malvasia Aromatica (Malvasia di Lipari), a key variety for the Canary Islands viticulture, grown mainly on La Palma and Tenerife.

Source: <https://dovalleorotava.com/en/grape-varieties/>

**Malvasia Volcánica** (also known as Malvasia de Lanzarote) is a heritage white grape variety indigenous to the Canary Islands, particularly Lanzarote (Fig. 6). It is distinct for its adaptation to volcanic environments and its unique genetic heritage (a natural cross between Malvasia Aromática and Marmajuelo (Rodríguez-Torres et al. 2009). It is recognized by the OIV as a unique variety separate from other Malvasias.

The variety has a distinct morphology. Leaves are medium-sized, round, and typically have five lobes with medium undulation on the upper blade. The petiolar sinus is slightly open and wedge-shaped. The grape bunches are funnel-shaped and medium in density, often featuring three long wings. The average bunch weight is approximately 400g. The berries are small to medium, round (approx. 16mm), with green to yellowish skin. The flesh is soft, very juicy, and

aromatic. The vine has a low to medium vigour with a semi-erect shoot attitude. Shoots can grow very long (up to 5 m) and have a high tendency to form lateral shoots.



Figure 6. Malvasia Volcánica, the unique grape of Lanzarote. Source: <https://dovalleorotava.com/en/grape-varieties/>

The variety is highly susceptible to Oidium (powdery mildew), shows medium susceptibility to Botrytis and Peronospora (downy mildew). Regarding vulnerability to pests, it is vulnerable to caterpillars such as *Cryptoblabes gnidiella* and damage from birds. Since most vines are grown on their own roots (European roots) because the volcanic soils of the Canary Islands are naturally tolerant to the phylloxera aphid.

Concerning ecology and cultivation, this variety thrives in “picón” or “lapilli” (porous volcanic ash). This layer acts as a mulch, capturing night moisture from Atlantic winds and preventing evaporation from the subsoil. Cultivation techniques are adapted to the extreme volcanic terroir:

- **Hoyos:** Deep, funnel-shaped pits (up to 4m deep) dug through ash to reach fertile clay subsoil.
- **Zanjas:** In areas with thinner ash, vines are planted in long trenches.
- **Zocos/Abrigos:** Semi-circular stone walls built around pits to protect vines from fierce trade winds.

Planting density is extremely low (200–800 plants per hectare). Yields are minimal, often between 500–1500 kg per hectare, resulting in highly concentrated fruit. Harvest is manual due to the challenging terrain.

**Marmajuelo** (or Bermejuela) a rare but revitalized variety found mostly on La Gomera and El Hierro that has experienced a recent revival due to its potential for high-quality wines (Fig. 7). Modern genetic testing (SSR markers) has failed to find a matching genotype in global databases, categorizing it as a highly distinctive local variety (Marsal et al. 2019).

The Marmajuelo vine has distinct physical characteristics such as small to medium-sized, loosely packed clusters with small and round berries with thick, pale-yellow skins. Although the vine is known for its hardiness and adaptability to the local climate and volcanic soils, it is highly susceptible to coulure (shattering/fruit set failure), which historically limited its cultivation. Genetically, the vine is predisposed to produce high levels of specific thiols (mercaptans) like 3-

mercaptohexyl acetate. These compounds give the wine its characteristic “tropical” profile (passion fruit, pineapple) and vibrant salinity, which are distinct from other white varieties like Listán Blanco or Malvasía (López et al. 2003).

intense muscat taste. Concerning the viticultural practices the vine prefers short pruning, typically managed in a gobelet (bush vine) system or covered training systems. Produces regular but not overly abundant yields; limiting yields is often necessary to concentrate its highly sought-after varietal aromas. It is highly susceptible to powdery mildew and sensitive to downy mildew, grey rot (*Botrytis*), and various insects.

In the Canary Islands it is often grown on terraces in mid-altitude zones (200–400 metres) to maximize soil use and manage erosion.

**Verdello** originates from Portugal and is the same variety found in Madeira and the Azores under the name Verdelho (Fig. 9). It is distinct from the Italian “Verdello” grown in Umbria and Tuscany. In the Canary Islands it is a highly valued white grape variety primarily found on the islands of La Palma, Tenerife, and La Gomera. It is also the parent of local varieties like Albillo Forastero (La Gomera) and Albillo Criollo (La Palma).

This vine has a short growing cycle with early to mid-season bud break and ripening, generally produces low yields. It is easily trainable and can be pruned short or moderately long. The vigour is moderate to strong with a semi-erect to horizontal growth habit. The mature leaves are medium-sized, pentagonal, and typically have five lobes with a characteristic V-shaped or U-shaped petiolar sinus. The bunches are small to medium in size, typically dense and compact with small-medium, round to oval berries with thick skins that have a waxy, greenish-yellow hue.

The variety produces high-quality, distinctive white wines characterized by volcanic minerality, high acidity, and tropical fruit profiles.

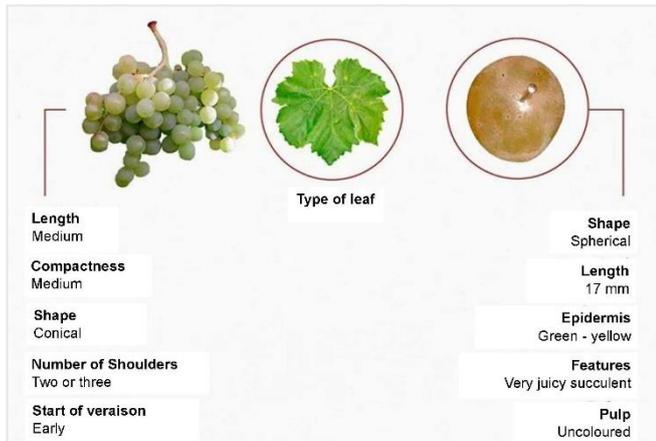


Figure 7. Marmajuelo (Bermejuela), endemic variety.  
Source: <https://dovalleorotava.com/en/grape-varieties/>

**Muscat of Alexandria** (Moscatel de Alejandría) is an ancient aromatic grape, a significant late-season variety prized for its aromatic intensity and historical resilience, used for table consumption, raisins, and aromatic wines (Fig. 8). While grown across the archipelago, it is most notable in Lanzarote (especially the La Geria region), Tenerife, and Fuerteventura. The vine is generally described as having high vigour and an upright or drooping growth habit depending on the specific clone. The leaf is Medium-sized, typically three-lobed with an often-closed V-shaped petiolar sinus. Interesting, that the vines tend to age fairly quickly compared to other varieties.

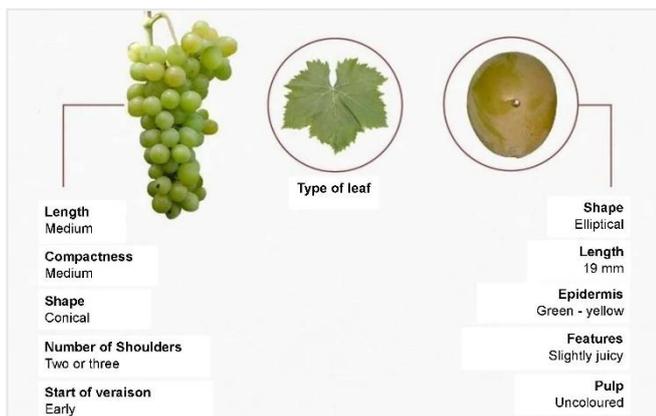


Figure 8. Muscat of Alexandria, the ancient variety has been a parent in numerous natural crosses worldwide.  
Source: <https://glossary.wein.plus/muscat-d-alexandrie>

The underside is mostly hairless or only slightly hairy. The bud features a greenish-whitish, hairy apex.

The grape cluster is large and conical-pyramidal in shape, weighing between 270–350 grams with medium to very large sized ovoid berries which have a yellow-greenish hue and a thick, resistant skin and crunchy pulp with a characteristic



Figure 9. Verdello (Verdelho) is a flexible variety that adapts to coastal climates and is known for its drought resistance.  
Source: <https://dovalleorotava.com/en/grape-varieties/>

Regarding its susceptibility to pathogens, it is highly susceptible to Powdery Mildew (*Oidium*), making careful canopy management essential; has a medium susceptibility to *Botrytis* (bunch rot) but much more sensitive in wetter climates. It has a low susceptibility to Downy Mildew (*Peronospora*). As far as abiotic stress resistance is concerned,

it is robust against excessive humidity and notably drought-resistant in warmer regions.

**Vijariego Blanco** (also known as Diego or Verijadiego) is truly one of the "heroic" grape varieties of the world, it is known as the most acidic grape variety in the islands, a versatile grape used for dry, aromatic, and even sparkling wines, notably in El Hierro and Tenerife (Fig. 10).

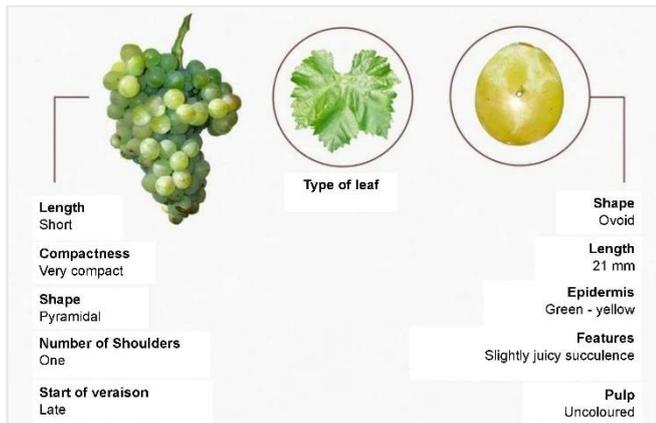


Figure 10. Vijariego Blanco (Verijadiego) known as the most acidic grape variety in the islands. Source: <https://dovalleorotava.com/en/grape-varieties/>

Although synonymous with the Canary Islands today, it likely originated in the Granada region of Andalusia. It was brought to the Canary Islands in the 15<sup>th</sup> century. While it was once widely cultivated across Andalusia, the phylloxera epidemic at the end of the 19<sup>th</sup> century nearly eradicated it from the Spanish mainland. Finally, it found refuge in the Alpujarra of Granada and on the islands of El Hierro, Tenerife, and La Palma. Recent studies clarify that Vijariego Blanco (Diego) is a distinct variety and not a mutation of the red Vijariego. It is also known as Bujariego, Derijadiego, Vijiriego, and Vujariego. As many vines in the Canary Islands, even this variety is ungrafted (*pie franco*) because phylloxera never reached the archipelago, allowing for the preservation of ancient genetic material.

This late-ripening variety is highly adaptable to diverse environments, growing at altitudes ranging from 200 m to 1,400 m above sea level (among the highest in Europe). It is a vigorous and productive variety, which produces a small quantity of medium-sized, pyramidal, and relatively loose clusters with large, round to broad-ellipsoid, and pale green berries of whitish-greenish tones.

Characterized as a robust, stress tolerant variety, particularly well-suited for high-mountain cultivation and organic viticulture. Highly susceptible to phylloxera, (historically devastated on the mainland), though protected by the geographical isolation of the Canary Islands. As most Spanish minority varieties, including close relatives, it shows high susceptibility to Downy Mildew (*Plasmopara viticola*) and Powdery Mildew (*Erysiphe necator*), though specific field data for Vijariego Blanco often categorizes it as generally "hardy" in its native island microclimates.

## Key Red Varieties

**Listán Negro** (also known as Almuñeco) is a red grape variety primarily associated with the Canary Islands, known for its adaptability to volcanic terroirs and distinct mineral characteristics (Fig. 11). Originally from the Spanish mainland, it was brought to the Canary Islands as early as the 15<sup>th</sup> century.

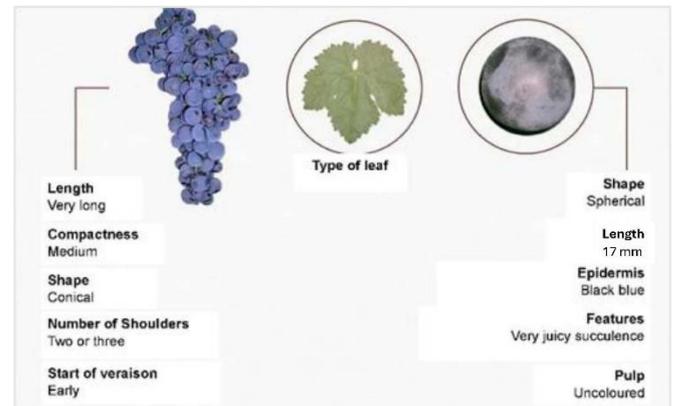


Figure 11. Listán Negro (Almuñeco) a very vigorous and disease and pest resistant grape variety. Source: <https://dovalleorotava.com/en/grape-varieties/>

It is now considered a native "island grape" of the archipelago, a natural crossing between the red Negramoll (Mollar Cano) and the white Listán Blanco (Palomino Fino).

Listán Negro is frequently confused with Listán Prieto, which is genetically identical to the American Mission/País grape, but Listán Negro is a distinct variety. It is the most widely planted red variety in the archipelago, covering over 5,000 hectares. It is a permitted variety in multiple DOs, including Tacoronte-Acentejo and Valle de la Orotava. While primarily concentrated in the Canaries, it has historically spread to parts of South America (Chile, Argentina) and North America (California) via Spanish explorers.

Listán Negro is a highly vigorous and productive vine with good fertility. The ampelographical characteristics are distinctive, it has large, pentagonal leaves with five slightly overlapping lobes; medium to exceptionally large bunches (some reaching up to 1 kg), which are compact and cylindrical with medium-sized, spherical/globose berries with a distinct blackish-blue hue.

The vine shows a high resistance to bunch rot (*Botrytis cinerea*), generally considered reliable and pest-tolerant, has moderate susceptibility to both Downy and Powdery mildew while susceptible to the grapevine trunk disease, Esca caused by the fungi *Phaeoacremonium aleophilum*, *Phaeoconiella chlamydospora* and *Fomitiporia mediterranea* (Marín et al. 2012; Fischer, 2002).

Listán Negro is a versatile grape that produces wines ranging from light-bodied rosés to medium-bodied reds, sometimes aged in oak for more complexity. The wines are typically light to medium-bodied with vibrant, balanced acidity and soft to medium tannins and exhibit notes of red fruits like cherry, raspberry, and strawberry, along with hints of black pepper,

wild herbs, and a notable smoky or mineral character derived from the volcanic soil.

**Baboso Negro** is a highly regarded red grape variety known for producing intense, complex wines. While considered an indigenous variety of the Canary Islands (especially Tenerife), it originally arrived from Alentejo, Portugal.



Figure 12. Baboso Negro. Source: <https://dovalleorotava.com/en/grape-varieties/>

It is most prominently cultivated on the islands of El Hierro and Tenerife. While considered indigenous to the Canary Islands since the 16<sup>th</sup> century, genetic studies identify it as Alfrocheiro Preto from Portugal's Alentejo region also known as Albarín Negro in Asturias, Caino Gordo in other parts of Spain, and Alfrocheiro in Portugal (Cunha et al. 2015). It is genetically similar to the French variety Trousseau (known as Bastardo in the Iberian Peninsula), though it typically produces wines with deeper colour and firmer tannins.

The vine is described as highly vigorous, with typical large, five-lobed leaves, small to medium-sized, conical, and extremely compact clusters with small to medium black berries with thin skin and a high skin-pulp ration. It is a late-ripening variety, generally low-yielding, which contributes to its concentration and high quality but makes it difficult to cultivate commercially. Trellises (espaldera) are used as training systems to handle its high vigour and improve airflow.

The wines are medium to full-bodied with intense colour, high acidity, and firm tannins. They are characterized by ripe black fruits (blackberry, plum), floral notes (violets, dry rose), and spicy or balsamic undertones. Due to their high acidity and tannin structure, the wines have excellent aging capacity, developing complex leather and earthy notes over time.

**Vijariego Negro** is a rare red grape variety, which has been revitalized in the Canary Islands after nearly facing extinction. It most likely originated in Andalusia and was introduced to the Canary Islands in the 15<sup>th</sup> century during colonization. Modern DNA analysis identifies it as the same variety as Sumoll, which is still found in Catalonia (Fort et al. 2023). Research also suggests that it is a natural cross between the historical variety Heben and an unknown male parent. It is distinct from Vijariego Blanco and is not merely a colour mutation. It is historically linked to El Hierro and is

now also cultivated in Tenerife (notably the Orotava and Ycoden-Daute-Isora regions), La Palma, and Lanzarote. In mainland Spain small populations exist in Andalusia (Granada) and Catalonia.

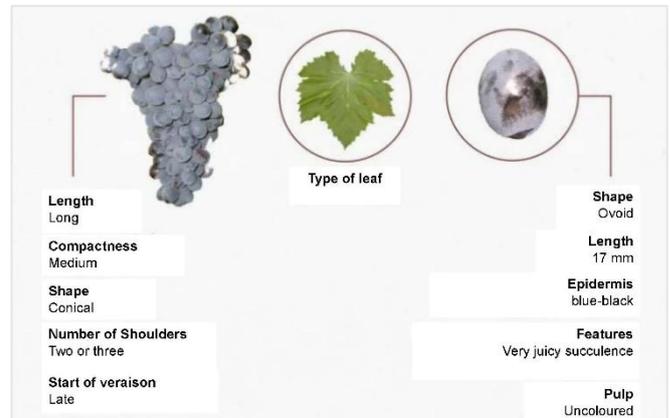


Figure 13. Vijariego Negro. Source: <https://dovalleorotava.com/en/grape-varieties/>

The vine is characterized by a long vegetative cycle and a high-yielding nature, producing medium-to-large, loose bunches with plump, juicy, black berries with thick skins. Preferring cooler vineyard sites and higher elevations (e.g., 700–800 meters), it thrives in volcanic soils and Atlantic climates. It is a relatively hardy vine; its thick skins provide protection in hotter climates. While generally resistant to many vine diseases, its long cycle requires careful management. Detailed susceptibility to specific fungal diseases is less documented than its general “hardy” reputation.

Wines of this variety are known for their high natural acidity, which provides freshness and structure. It is often used to add backbone to blends (frequently with Listán Negro) but is increasingly bottled as a single varietal. Typically exhibits notes of dark fruits (blackberries, cassis, figs), spices (pepper, clove), and a distinctive “smoky” or “volcanic” minerality. Often aged in oak (6–14 months) to soften its fine-grained tannins and enhance its complexity.

**Castellana Negra** is a red wine grape variety primarily cultivated in Tenerife (specifically Tegueste), it has spread to other islands like La Palma and El Hierro.

While it has been part of the Canary Island vineyards for centuries, its roots are traced back to the Portuguese regions of Dão and Porto, where it has been cultivated since the 17<sup>th</sup> century. DNA analysis (using SSR markers) confirms that Castellana Negra is genetically identical to the Portuguese variety Tinto Cão (Marsal et al. 2019).

It is characterized as vigorous variety with a long growth cycle, described as low-yielding, which contributes to the concentration and quality of its fruit. Produces small, short, and very compact, cone-shaped grape bunches with small, elliptical berries with uncoloured flesh.

Castellana Negra yields elegant, aromatic wines often characterized by a moderate alcohol-by-volume (ABV) because it reaches phenolic maturity at approximately 12°.

The wines are marked by aromatic elegance with notes of liquorice, wild fruits, and spices.

It possesses impressive tolerance to botrytis (bunch rot) and other common grape diseases, making it well-suited for regions with varying humidity.



Figure 14. Castellana Negra. Source: <https://dovalleorotava.com/en/grape-varieties/>

**Malvasía Rosada** is a rare, aromatic grape variety primarily cultivated in the Valle de la Orotava. It is a pink-berried mutation of Malvasia Aromatica (also known as Malvasia Dubrovacka or Malvasia de Sitges according to Rodríguez-Torres et al. 2009). The vines display a semi-erect growth habit. The clusters are smaller than the parent variety, often loose and pyramidal in shape, with medium-sized, roundish berries with a distinctive intense pink skin. Their flesh is juicy, colourless with a high sugar concentration (typically around 21° Brix) and low total acidity.

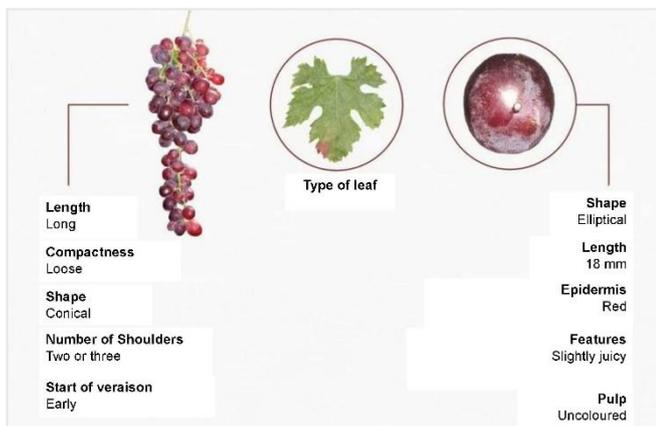


Figure 15. Malvasía Rosada. Source: <https://dovalleorotava.com/en/grape-varieties/>

Malvasia Rosada thrives in humid subtropical climates, particularly at altitudes of 300–350 meters in volcanic regions. It is highly adapted to volcanic soils, which impart a refreshing mineral finish to the wine. It prefers poor, well-drained soils to maintain quality and prevent rot. The vine adapts to various training methods, though cordon training is often recommended for its parents.

The variety is susceptible to grey rot and powdery mildew, making it unsuitable for overly humid or damp low-lying

areas. It can be sensitive to water stress and magnesium deficiency.

It produces aromatic, light-bodied wines ranging from dry to sweet and sparkling; typically a pale red or delicate crimson (often vinified as a “rosado” or light red) and features intense floral notes, red fruits, and a characteristic muscat aroma.

**Negramoll** is a historically significant red grape variety in the Canary Islands, particularly in Tenerife, often referred to as the region’s “Pinot Noir” due to its delicate profile. While widely considered native to the Canary Islands, DNA studies (Martin et al. 2006) revealed it is genetically identical to Mollar Cano from Andalusia, Spain. It was likely brought to the islands by missionaries in the 18<sup>th</sup> century. Furthermore, this genetic identification revealed that the variety is also identical to Tinta Negra Mole in Madeira, Portugal, and several vines in South America (such as in Peru, Chile, and Argentina) known simply as Mollar (Martinez et al. 2006).

Negramoll is a high-yielding, vigorous variety, produces large, loose clusters with large, soft-fleshed berries with thin, dark skins (leading to lower tannins and light color). A pink-berried mutation called Negramoll Rosada (or Mulato) also exists in Tenerife. In the Canary Islands, traditional systems like parral bajo (low trellis) are used. Often trained using spur-pruning or cane-pruning (Guyot) depending on the desired quality and yield balance.

This vine thrives in warm, maritime climates but is particularly drought-resistant, making it suitable for regions with scarce water availability. It is usually planted from near sea level up to mid-altitudes (approx. 300 m) to maintain freshness. It is generally tolerant to diseases, which contributed to its widespread planting in the 19<sup>th</sup> century. Its loose clusters help provide good air circulation, reducing rot risks.

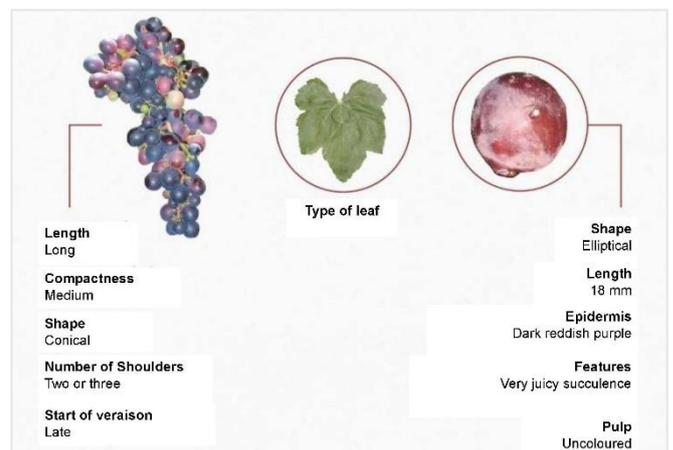


Figure 16. Negramoll – this variety often have clusters with a non-uniform colour, ranging from dark blue to pinkish. <https://dovalleorotava.com/en/grape-varieties/>

Negramoll produces light-to-medium-bodied red wines with low tannins and medium acidity. Known for aromas of red berries (strawberry, cherry), toffee, and spice, often with a smoky, volcanic minerality. In the Canary Islands, it is used for dry table wines (often blended with Listán Negro). In

Madeira, it is the primary grape for fortified wines, ranging from dry to sweet.

**Tintilla** is a rare, late-ripening red grape variety cultivated in the Canary Islands, particularly on Tenerife and Gran Canaria. While the name is often used as a synonym for other grapes, it is considered a distinct and unique variety within the archipelago.

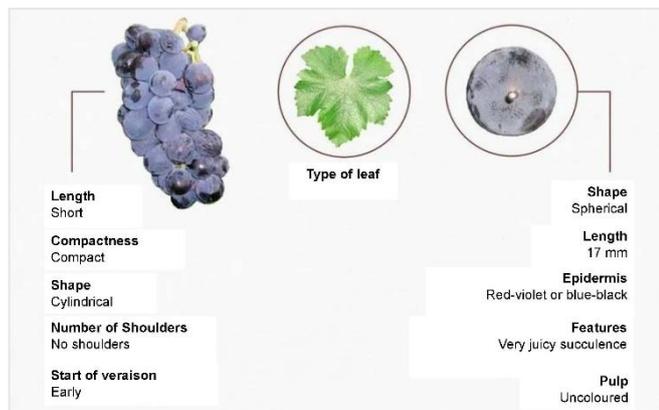


Figure 17. Tintilla has typical, short and compact clusters. Source: <https://dovalleorotava.com/en/grape-varieties/>

Although sometimes linked to the peninsular Graciano, it exhibits different behavioural traits and is described by regional authorities as having no close genetic connection to other local varieties.

Tintilla ripens late, often harvested in the third week of October giving low yield of compact bunches with darkly coloured, small, and juicy berries. The vine has a moderate vigour, requiring significant care to produce quality fruit.

Primarily thrives at high altitudes, typically above 600 metres (up to 1,400 m), where cooler temperatures preserve acidity. Traditionally grown as low-to-the-ground bush vines to protect against high winds but in the Orotava Valley, it may be part of the unique “braided cord” system.

This variety is highly drought-tolerant and tolerant to ferric chlorosis, making it suitable for the hot, dry microclimates of the islands. It is susceptible to downy mildew, powdery mildew, and botrytis (bunch rot), especially in humid or high-wind coastal areas.

Tintilla produces wines with intense colour, high pigmentation, and vibrant acidity. Its aroma profile is characterized by spicy aromas of black fruit, scrubland, and earthy, rustic notes like black pepper or sandalwood. Tintilla is frequently used as a blending component to add complexity, structure, and colour to varieties like Listán Negro, though single-varietal “cellaring” versions are increasingly produced.

While native grapes dominate, limited plantings of international varieties like Syrah, Cabernet Sauvignon,

Tempranillo, and Merlot are used, primarily as blending components to add structure or body.

### The gene bank potential of the indigenous grape varieties

The indigenous grapes of the Canary Islands represent a critical “living gene bank” for global viticulture. This unique genetic heritage is represented in ancient lineages, recently discovered new varieties and a high intra-varietal diversity. Vines introduced in the 15<sup>th</sup> century have evolved through 500+ years of isolation, mutations, and natural hybridization, creating unique “DNA fingerprints” found nowhere else on Earth. Recent genomic studies have identified dozens of previously unknown varieties, such as Aromatica Eufrosina, Cagarruta de oveja, and Viñarda rosada on La Palma. Research highlights exceptional variability within single varieties, such as Malvasia volcanica and Listan prieto, which offer a deep well for clonal selection (Lin-Yang et al. 2025).

The gene bank potential of these grapes is increasingly valuable for climate change adaptation in terms of:

- **Drought & Heat Resistance:** Varieties like Listan Blanco and Majorera have adapted to desert-like conditions and low rainfall, offering genetic traits for heat-tolerant viticulture.
- **Volcanic Resilience:** The vines thrive in young volcanic soils and have survived recent eruptions (like Tajogaite in 2021) without significant loss of biodiversity.

Ongoing efforts include the creation of “living museums” like the Jardín de Variedades Canarias, which houses over 80 identified varieties.

### WINE REGIONS OF THE CANARY ISLANDS AND THE DENOMINATIONS OF ORIGIN (DOPS)

The extreme variability of wine terroirs has led to the establishment of 11 distinct Denominations of Origin (DOPs, (Denominación de Origen Protegida) on the Canary Islands.<sup>1</sup> Established in 2011/2012, this is a regional appellation that encompasses the entire archipelago (Fig. 18). It allows for blending grapes across different islands and provides a unified brand (“Canary Wine”) for international recognition. It technically sits one step above Vino de la Tierra (IGP) but operates alongside the island-specific DOPs. Since 2021, it has introduced specific sub-labels for Regional, Island, Municipal, and Single Parcel wines to highlight specific terroirs. There are 11 distinct DOPs across the islands:

Tenerife (5 DOPs) is the most complex island with five unique zones, which are shaped by the island's diverse microclimates around Mount Teide.:

1. Tacoronte-Acentejo (the oldest, est. 1992)
2. Ycoden-Deute-Isora
3. Valle de la Orotava
4. Valle de Güímar
5. Abona (includes some of Europe's highest vineyards)

<sup>1</sup> <https://canarianessentialwines.com/category/wineries/>

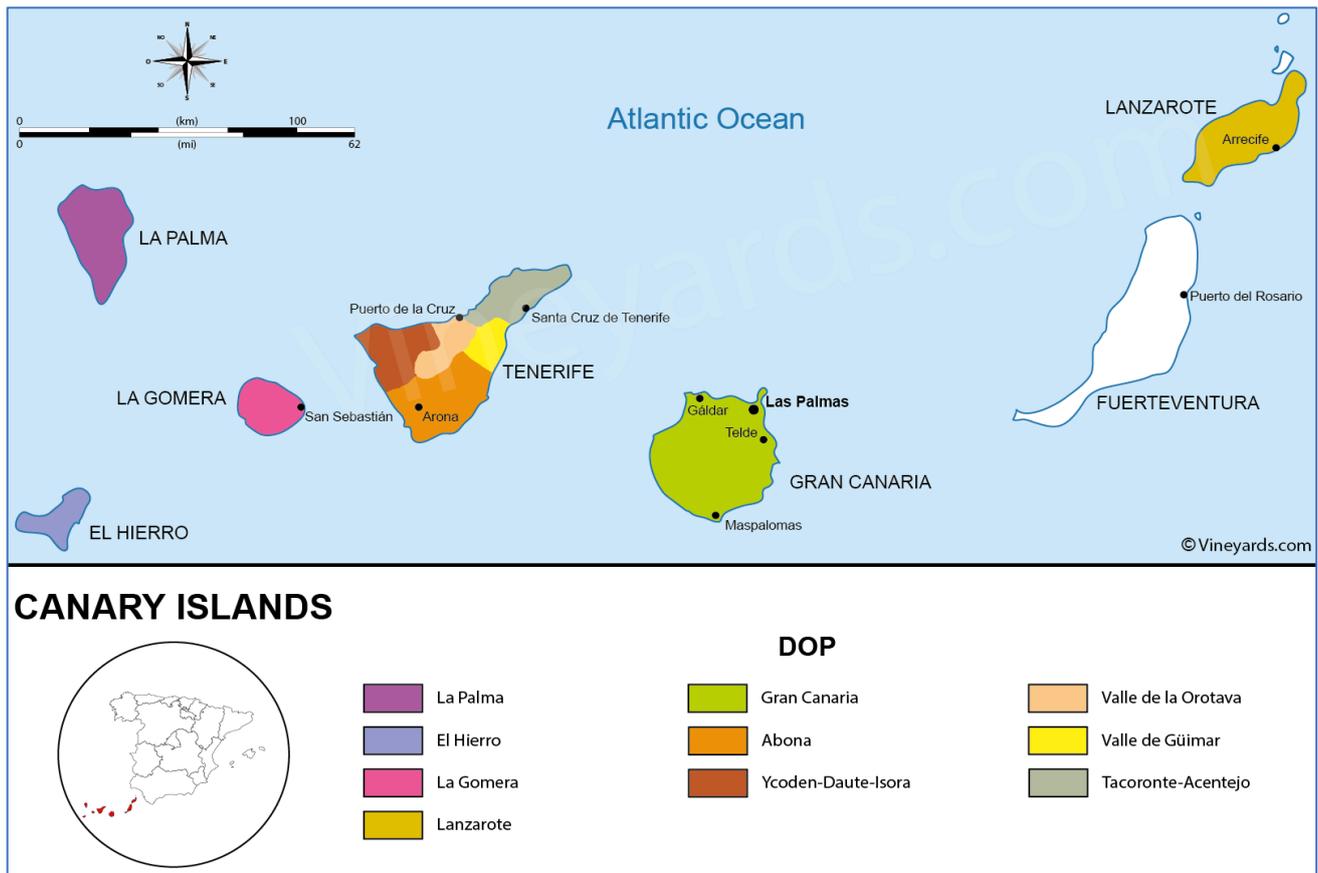


Figure 18. Denominations of Origin (DOPs) of the Canary Islands. Tenerife alone has 5 DOPs and there are other 5 DOPs for the individual islands La Palma, La Gomera, Gran Canaria and Lanzarote. Fuerteventura does not have its own exclusive island-wide DOP. Instead, its high-quality wines are certified under the DOP Islas Canarias.

Source: <https://vineyards.com/wine-map/spain/canary-islands>

#### Individual Island DOPs (5 DOPs):

1. Lanzarote is famous for its “lunar” volcanic landscape and vines planted in deep ash (picón).
2. La Palma.
3. Gran Canaria.
4. El Hierro.
5. La Gomera.

Fuerteventura: While growing grapes, it primarily produces under the regional DOP Islas Canarias.

#### The DOPs of Tenerife

Tenerife is the only island in the Canary Islands with multiple sub-island Denominations of Origin (DOP).

**Tacoronte-Acentejo** is the oldest DOP established 1992 (Fig. 19). The region’s vineyards are predominantly situated on steep, terraced slopes on the northern side of the island, benefiting from the Atlantic Ocean’s influence and trade winds.

The terrain is defined by the island’s volcanic backbone, creating multiple microclimates. Tacoronte-Acentejo is well known for producing high-quality wines, with red wines making up about 80% of the total production.

The main red grape is Listán Negro, though the specific varieties for this region are diverse. The key white varieties include Listán Blanco, Malvasía Aromática, Marmajuelo, and Albillo Criollo.

Organic and sustainable viticulture is a growing trend in this DOP, driven by a new generation of winemakers focusing on minimal-intervention and preserving ancient, ungrafted vines. Many producers have shifted away from intensive chemical use, favoring “natural” winemaking to better express the volcanic terroir. Wineries in Tacoronte-Acentejo are serving as models for other islands by introducing innovative developments that balance modern technology with ecological preservation. Some highly regarded organic wineries in the region include Presas Ocampo, Bodega El Sitio de San Juan, Bodega Tierra Fundida, and Bodegas Monje in El Sauzal.

**Ycoden-Daute-Isora** DOP, established in 1994, covers nine municipalities, including the towns of Icod de los Vinos and Guía de Isora. The name is derived from the ancient Guanche kingdoms of Ycoden and Daute and the lands of Princess Isora, reflecting the area’s rich history.

Vineyards are situated on the slopes of the Teide volcano, at altitudes varying between 50 and 1,400 metres above sea level, contributing to a wide range of microclimates. Grape

Varieties are mainly autochthonous, with Listán Blanco accounting for about 70% of plantings and Listán Negro about 20%. Other varieties like Malvasía and Tintilla are also grown. The region is primarily renowned for its excellent white wines, but also produces quality red and rosé wines, as well as traditional sweet Malvasía wines. Several wineries produce organic wines in the Ycoden-Deute-Isora DOP of Tenerife, including, Reverón Wines and Bodegas Viñátigo.



Figure 19. The vineyards of the organic winery Presas Ocampo in Tacoronte-Acentejo region of Tenerife. Source: <https://john-house-dbkh.squarespace.com/o-campo>

**Valle de la Orotava DOP** (established in 1995) is located on the north side of the island of Tenerife encompassing the municipalities of La Orotava, Los Realejos, and Puerto de la Cruz. Vineyards extend from the coast to the foothills of the Teide volcano, at altitudes from 85 to 980 metres above sea level. A notable feature is the use of ungrafted rootstock (due to the absence of phylloxera) and the unique traditional cordón trenzado (“braided cord”) training system, where vine branches are woven into long, 8-meter or more, horizontal cords (Fig. 20). The region boasts a rich diversity of native grape varieties. Key white varieties include Listán Blanco, Malvasía, and Albillo Criollo, while significant red varieties include Listán Negro and Vijariego Negro.

The DOP produces white, red, and rosé wines. White wines are typically straw yellow, fruity, and well-balanced, while reds are smooth with varying bouquets. Organic wine production in the Valle de la Orotava DOP is a growing trend, with several wineries in the region implementing organic and biodynamic farming methods. Wineries like Suertes del Marqués, Bodega Ecológica Marzagana Elementales and Bodega Finca Marañuela are known for their natural and organic wines.

**Valle de Güímar DOP** is a wine region located in the south-east of Tenerife, covering the municipalities of Arafo, Candelaria and Güímar. Established in 1996, it is known for its ‘heroic viticulture’ due to the difficult conditions of the volcanic terrain and high altitudes, with vineyards stretching from near the coast to almost 1,500 metres. The soils are predominantly volcanic, and the significant temperature

difference between day and night at higher altitudes contributes to the quality and freshness of the grapes.



Figure 20. The unique traditional cordón trenzado (“braided cord”) training system in the Suertes del Marqués winery. Source: <https://escapementmagazine.com/articles/suertes-del-marques-wines/>

White wines account for roughly 80% of production and are generally pale yellow, fresh, and fruity with notes of citrus, tropical fruits, and minerals. The primary grape varieties are Listán Blanco (Palomino), Malvasía Aromática, and Albillo Criollo. The region also produces rosés with red berry bouquets and red wines with earthy notes.

Organic viticulture is practiced by some wineries within the region, such as Bodegas Ferrera, Bodega Tempus and Slow Food Finca Marañuela.

**Abona DOP** is located on the southern slopes of Tenerife and boasts extreme variations in altitude, with some terraced vineyards among the highest in Europe, reaching up to 1,700 metres above sea level. The soils are predominantly sandy and clayey, mixed with “jable” (white volcanic ash), rich in minerals and retain humidity well.

There are both white and red grape varieties in Abona, although white wines represent the majority of production. The main white varieties are Listán Blanco (the most widely planted), Gual, Malvasía (both Aromática and Volcánica), Bermejuela, Moscatel, and Verdello. Other authorized whites include Bastardo Blanco, Forastera Blanca, Sabro, Torrontés, Vijariego, Albillo, Doradilla, and Pedro Ximénez. The main red varieties are Listán Negro (the most preferred red variety), Negramoll, and Moscatel Negro. Other authorized reds are Tintilla (Trousseau), Malvasía Rosada, Vijariego Negro, Bastardo Negro (Baboso Negro), Castellana Negra, and Listán Prieto. Although the indigenous varieties dominate, even international varieties are cultivated such as Cabernet Sauvignon, Merlot, Pinot Noir, Ruby Cabernet, Syrah, and Tempranillo.

While many producers here use traditional methods that are naturally “close to organic” due to a semi-desert climate and high altitudes that naturally minimize pests and diseases, several key wineries are explicitly recognized for their organic practices. Well known examples include Bodega Frontos in Granadilla de Abona, Reverón Wines, and Bodega Lagar de Chasna.

## Individual Island DOPs

**Lanzarote** is renowned for its exceptional viticulture in a unique volcanic “lunar” landscape, focusing on native grape varieties and producing distinctive wines with marked minerality and acidity.



Figure 21. Vineyards of La Geria, Lanzarote: vines are planted in excavated pits (hoyos) in the fine volcanic tephra, deposited by the 1730 – 1736 eruptions. Each pit (~3 m in diameter), is protected by a semicircular low wall (Zocos/Abrigos) providing shelter against the persistent tradewinds. Source: Pérez, 2016.

<https://doi.org/10.3934/agrfood.2016.3.265>

The viticulture in Lanzarote is a form of heroic agriculture (Fig. 21), primarily characterized by the use of hoyos (pits) or chabocos (fissures in lava) to cultivate individual vines. The key features of this viticulture are the following:

- **Picón (Volcanic Ash):** A layer of this porous ash covers the island, acting as a natural mulch that retains hygroscopic moisture from dew and minimal rainfall, allowing the vines to survive in the arid climate.
- **Semi-circular Walls (Zocos/Abrigos):** Low, semi-circular walls made of volcanic rock are built around each pit to shield the young vines from the constant, hot, and dry trade winds, which are a major challenge in the region.
- **Manual Labour:** The distinctive layout of the vineyards makes mechanization impossible, so all work, including harvesting, is done manually.
- **Pre-Phylloxera Vines:** The Canary Islands were never affected by the phylloxera plague, meaning many vines are grown on their own rootstocks (pie franco), a rare practice today.

White grape varieties dominate, with Malvasía Volcánica being the flagship grape. The most planted red grape is Listán Negro. Other important varieties include Moscatel de Alejandría (often used for sweet wines), Listán Blanco (known as Palomino Fino elsewhere), and Diego (Vijariego Blanco), which is prized for its high acidity and potential for aging.

Viticulture in Lanzarote naturally involves minimal intervention, and some winemakers are embracing certified and non-certified organic and natural wine practices. Minimal intervention is the norm, with some producers using spontaneous fermentation and lower-than-permitted sulfite levels. The inherent resistance of the vines and the unique growing environment contribute to these low-intervention methods.

Several wineries are known for their commitment to quality and, in some cases, natural/organic production including Bodegas El Grifo (one of the oldest wineries in the Canary Islands), Bodega La Geria in Timanfaya National Park, Bodega Los Bermejos and Bodega Vulcano de Lanzarote.

**La Palma**, the DOP established in 1994, covers the entire “Isla Bonita,” where vines are cultivated on dramatic volcanic landscapes ranging from 200 to 1,500 metres above sea level. The island is a UNESCO Biosphere Reserve with a rugged geography that creates numerous microclimates.

Vineyards are planted primarily in volcanic soils, including black ash (picón) in the south and deeper, more fertile soils in the north. Saline content is often present in coastal plots due to the Atlantic influence. There are three viticultural sub-zones on the island:

- **Fuencaliente (South):** Arid, volcanic ash landscapes; home to the historic Malvasía.
- **Hoyo de Mazo (East):** High central slopes with stony soils.
- **Norte de la Palma (North):** Steeper, greener terrain with higher rainfall.

La Palma is a sanctuary for rare, ungrafted (phylloxera-free) indigenous varieties:

- **White:** Malvasía Aromática (the island’s star), Albillo Criollo, Listán Blanco, Bujariego, and Gual.
- **Red:** Negramoll (most widespread), Almuñeco (Listán Negro), and Tintilla.

Extreme, steep slopes and manual labour define the island’s unique viticulture. The vine cultivation is characterized by two main training systems:

- **Bush Vines (Rastreadizo):** Traditional low-lying vines that hug the ground to protect against Atlantic winds and retain soil moisture.
- **Trellis (Espaldera):** More modern vertical systems used to increase yields and facilitate air circulation.

The island produces distinct wines ranging from sweet Malvasía to unique, pine-aged “Vinos de Tea” a unique local tradition where wines are aged in barrels made from Canarian pine (tea), imparting a distinct resinous aroma. The DOP also produces fresh Atlantic whites and aromatic reds.

Viticulture on La Palma increasingly integrates organic and biodynamic principles, driven by a growing global demand for sustainable wines and the island’s unique volcanic terroir. La Palma is a particularly compelling case study because its “heroic agriculture”—farming on steep, volcanic slopes—lends itself naturally to artisanal, low-intervention methods. Producers are leveraging the island’s extreme verticality. While conventional farming still exists, numerous producers are adopting organic standards, which prohibit synthetic pesticides, relying instead on copper and sulphur salts to

manage fungal diseases. Traditional hand-harvesting remains prevalent, especially in steep or high-altitude vineyards, to ensure grape quality and minimize soil compaction.



Figure 22. Terraced vineyards on La Palma. Source: <https://guiapenin.wine/8-vineyards-spain-breathtaking-sight>

Several wineries are prominently featured in events like the “Noche en Tinto” and Tim Atkin’s Canary Islands Top 100, often highlighting sustainable or craft practices such as Bodega Tierra Fundida, Linaje del Pago, Bodega LoHer, Ambora and Bodega Monje (Highly rated for tours and traditional techniques).

**Gran Canaria DOP** covers the entire island of Gran Canaria, integrating 21 municipalities. It is a rare viticultural bastion where pre-phylloxera European vines have survived and evolved in isolation for centuries. The island’s topography is divided into a younger northern half and an older southern half characterized by steep cliffs and ravines. Altitudes range from nearly sea level to 1,450+ metres, creating diverse microclimates influenced by Atlantic trade winds and a Mediterranean climate. While primarily volcanic, soil textures and structures vary based on their formation era, often providing significant mineral and saline content.

The DOP recognizes nearly 24 local grape varieties. The most cultivated whites are Listán Blanco, Malvasía Volcánica, Albillo Criollo, Verdello, Breval, and Marmajuelo while reds include Listán Negro and Negramoll.

Viticulture is characterized by ancient systems such as El Parral (pergola) and Vaso Irregular (bush vine). As in the whole archipelago, vines are often grown on their own roots (pie franco). The fragmented, mountainous landscape often requires specialized, manual management of small cultivation plots. Traditional methods include bush vines (en vaso) to protect against wind and heat. Specialized systems like the braided cord (cordón trenzado), while more common in Tenerife, highlight the region’s focus on manual, artisanal viticulture.

This region produces crisp, mineral-driven whites, light and fruity reds with volcanic character, and historically famous sweet Malvasía wines. As of 2016/2017, approximately 2,205 hectolitres were produced across 231 hectares. Modern wine trade aims at a circular economy, diversifying the island’s economy beyond mass tourism. The organic wine production of DOP Gran Canaria continues to evolve within a region known for its unique volcanic terroir and high concentration of microclimates. While many wineries in Gran Canaria

practice sustainable viticulture, several winemakers are recognized for organic or “low intervention” natural production such as Bodegas Mogarén, Bodega San Juan, Frontón de Oro and Tamerán (Clarke, 2025).



Figure 23. The organic vineyards of Bodega San Juan. Source: <https://vinosdegrancanaria.es/bodega-san-juan/>

**El Hierro** is the Denomination of Origin for the smallest and youngest of the Canary Islands. Soils are entirely volcanic, formed roughly a million years ago. They feature characteristic formations like lapilli (volcanic gravel), black sands, and basalt. They are generally poor in nutrients but possess excellent water retention properties, which is vital for the vines. Diverse types include clay, marl, and volcanic ash.

The island has a moderate to cool climate influenced by the Atlantic’s Trade Winds and the Canary Current. Cloud condensation at varied altitudes creates distinct microclimates, ranging from dry areas near sea level to humid zones at higher altitudes.

The main white grape varieties are Vijariego Blanco (also known as Verjadiego), Listán Blanco (Palomino fino), and Bermejuela (Marmajuelo). Other white varieties include Gual, Malvasía, and Moscatel. The main red varieties are Listán Negro (most common), Vijariego Negro, Negramoll, Tintilla, and Bastardo Negro.

Most vines are traditionally trained as low bushes (en vaso). They are often planted at a low level to protect them from strong winds. Due to the island’s steep slopes, vineyards are frequently planted on manually built stone terraces.

Newer plantings are increasingly adopting trellis systems (en espaldera) for easier management.

There is a strong movement toward organic practices to preserve soil biodiversity and reflect true terroir. Wineries like Bodega Uwe Urbach produce certified ecological (organic) wines using blends of traditional varieties. The island’s designation as a UNESCO World Biosphere Reserve and Geopark encourages sustainable, environmentally respectful craftsmanship.

El Hierro is primarily known for dry, fresh white wines intended for young consumption. It also produces reds, rosés, and a small amount of traditional sweet and fortified wines. Production is very small, with most wines consumed locally

on the island or across the Canary Islands. The region currently has about 13 wineries and over 200 vine growers, with the local cooperative traditionally controlling a large share of production.

**La Gomera DOP** established in 2003, is a wine-growing region in an extreme volcanic terrain. The appellation covers approximately 120–125 hectares of vineyards managed by about 15–22 wineries. The island is formed from volcanic material dating back 10 million years, creating a dramatic landscape of deep ravines, cliffs, and basalt outcrops. Soils are rich in minerals; wines from La Gomera specifically show significantly high levels of manganese.

La Gomera has a moderate subtropical climate influenced by trade winds and the Canary Current. Microclimates vary by altitude (300m to 1,300m) and orientation.

The flagship grape variety is Forastera Gomera (Forastera Blanca Junoniense), unique to the island and occupying 85–90% of production (Fig. 24). What makes this grape truly special is its status as a "living fossil" in the world of viticulture. Genetic studies have confirmed the Forastera Gomera as a distinct and unique variety, preserved on La Gomera for about 500 years (Fort et al. 2023; Marsal et al. 2019).



Figure 24. Forastera Gomera (Forastera Blanca Junoniense) the unique grape variety of the island of La Gomera. Source: <https://www.canariadiario.com/la-uva-forastera-una-variedad-antigua-y-muy-singular>

It accounts for the vast majority of white grape production on the island. It produces fresh, aromatic, and mineral-rich white wines. Other whites are Listán Blanco, Malvasia, and Marmajuelo. Red varieties include Listán Negro, Negramoll, Tintilla, and Castellana. Vines are grown on steep, man-made stone terraces with slopes ranging from 40 to 60 degrees, making mechanization impossible.

Historically, vines were left to grow along the ground. Modern vineyards often use trellising (espaldera) or medium-height systems to improve aeration and ripening. La Gomera is a UNESCO Biosphere Reserve and an ecological model for sustainable agriculture. There is a strong local commitment to permaculture and circular economy practices to preserve the landscape and prevent erosion (Fig. 25). Due to the terrain, all work from planting to harvesting is done entirely by hand. The DOP La Gomera is known for young, dry whites with floral and mineral notes, as well as characterful reds and rosés. While historically a well-kept secret, DOP La Gomera wines are now gaining international recognition and awards.

Production is small, often limited to around 130,000 bottles annually.



Figure 25. La Gomera, Valle de Gran Rey, where permaculture-inspired organic agriculture is practised, grapevine cultivation is well-integrated with other crops.

Source: <https://lagomera.travel/en/experiences/an-ecological-island-the-sustainable-model-of-la-gomera/>

**Fuerteventura** does not have its own independent DOP, the vineyards on the island are covered under the Canary Islands Protected Designation of Origin (DOP Islas Canarias), which was established in 2012 to consolidate regional production. While it has the smallest vineyard surface area in the archipelago—approximately 10 hectares—it is historically significant as the site where the first documented wines of the Canary Islands were produced in the early 15<sup>th</sup> century. Thus, even if recent wine production is low, historically Fuerteventura is a pioneer of Canarian viticulture, with projects now dedicated to recovering abandoned ancient vineyards and traditional knowledge.

Bodegas Conatvs, located in La Oliva, is the first winery in Fuerteventura with a PDO. The winery was born from the effort (conatvs is Latin for effort) to recover ancestral vineyards, which were the first in the Canary Islands, showcasing a blend of historical preservation and modern application. Vines are planted in ravines on fine sand and in volcanic gavia soil, which helps to retain moisture in the arid climate and protect the vines from strong winds. They champion high-range reds using native Canary Island grape varieties, such as Listán Prieto, which are well-adapted to the local conditions.

## THE CULTURAL HERITAGE OF CANARIAN WINE AND WINE TOURISM

Wine has been central to the islands' identity since the 15<sup>th</sup>-century Spanish conquest. The cultural heritage of wine in the Canary Islands is a living legacy shaped by over 500 years of history, volcanic geology, and the absence of phylloxera, which has preserved unique ancient vines.

### *Events and autumn celebrations*

Wine is central to the islands' social fabric, particularly during late autumn celebrations:

The Festival of Saint Andrew (Fiesta de San Andrés) is a deeply rooted tradition in the Canary Islands, especially in the north of Tenerife, celebrated on November 30<sup>th</sup> (with events often starting the evening before on the 29<sup>th</sup>). The festival is a lively blend of religious observance and ancient pagan/agricultural customs, marking the start of the winter season, the chestnut harvest, and the tasting of the year's new wine (vino del país).

Puerto de la Cruz, on the eve of San Andrés (November 29<sup>th</sup>) is known for the "running of the pots" or Fiesta del Cacharro (pots and pans). Children and tourists drag long strings of old tin cans and metal objects through the streets, creating an "almighty racket" to symbolically wake up the saint or perhaps just to add to the festive noise. A "Castañada" (chestnut feast) is also held in the Plaza del Charco, where typical island products like roasted chestnuts, sweet potatoes, and wreckfish are sampled with new wine.

Romerías are traditional pilgrimages across various municipalities always feature local wines (Trapero, 1989). A defining characteristic of a *bona fide romería* that free local food and wine are dished out from carts. The presence of local wines is considered essential to the celebration, which blends religious pilgrimage with a harvest festival atmosphere across various municipalities. Contemporary events like the Grand Wine Festival of Tenerife (September) and Saborea Lanzarote (November) combine heritage with modern gastronomy and music.

#### *The heritage of wine trade*

By the 16<sup>th</sup> century, "Canary" wines were prized by European royalty and famously praised by William Shakespeare in works like *Twelfth Night*. The islands were a crucial stopover for ships sailing to the Americas, and the wine played a significant role in early transatlantic trade. The "Wine Spill" of 1666 (Spanish: El Derrame del Vino) was a significant act of resistance by winegrowers in Garachico, Tenerife, in the Canary Islands. The event was a direct response to the monopolistic practices of the Canary Company, a British-led trading entity that sought to control the export of Malvasia wine by imposing artificially low prices on local producers. Therefore, on the night of August 14, 1666, a group of masked men entered the British-owned warehouses in the port of Garachico. They broke open hundreds of barrels, pouring thousands of litres of wine into the streets. The incident was described by historian José de Viera y Clavijo as one of the "strangest floods" in history, as the streets literally ran with wine. The protest succeeded in breaking the British monopoly, eventually leading to the dissolution of the Canary Company and a shift in the islands' trading power. A monument dedicated to the winegrowers' struggle, titled "Tribute to the Winegrowers," stands today along the avenue in Garachico.

While the most prominent events are in Tenerife, the festival of Saint Andrew, the patron saint of fishermen and winegrowers, is celebrated in various other towns and villages across the Canary Islands, reflecting its deep connection to the islands' agricultural and maritime heritage.

#### *Viticultural landscapes and wine tourism*

The viticultural landscapes of the Canary Islands are defined by traditional cultivation methods found nowhere else in the world, such as the hoyos in La Geria, Lanzarote, the "braided cord" (Cordon Trenzano) in La Orotava Valley Tenerife or the terraced vineyards of La Palma. These landscapes gained international cultural recognition like La Geria are recognized as Protected Natural Landscapes and contributed to Lanzarote's designation as a UNESCO Biosphere Reserve.

Elements like lagares (pre-industrial stone wine presses) transcend their role as archaeological relics to serve as active pillars of communal identity and living viticultural heritage. These stone structures are integral to the archipelago's "cultural landscape". Unlike forgotten ruins, they are actively promoted through wine tourism and interpretation centres as unique differentiators of the Canarian identity, particularly in unique volcanic regions like La Geria in Lanzarote. Modern viticulture increasingly integrates Tenerife winery tours and hiking through volcanic vineyards to sustain the territory and preserve these fragile landscapes.

The Canary Islands offer a unique wine tourism experience, with sustainable practices deeply rooted in their volcanic landscapes and several dedicated wine routes and museums across different islands (Lana, 2020). Wineries are increasingly adopting eco-friendly measures like organic farming, circular economy principles, and using local "zero-kilometre" products.

Official and suggested wine routes help visitors explore the unique viticulture of the islands. Gran Canaria Wine Route is the only extra-peninsular wine route in Spain, taking visitors through diverse microclimates, ravines, and volcanic soils to discover the island's unique winemaking traditions and cultural landscapes. Lanzarote's La Geria Region features a breathtaking itinerary of the 'lunar' landscape, where key routes include the Mozaga to Tinache and Barreto to Timanfaya routes. Tenerife (Orotava Valley and El Sauzal) is known for the unique "braided cord" vineyard management system. Visitors can explore this area and visit places like the Casa del Vino museum.

Several museums are dedicated to preserving and showcasing the rich winemaking history and culture of the Canary Islands. Casa del Vino (El Sauzal, Tenerife) is housed in a traditional 17<sup>th</sup>-century estate and features a museum with exhibits on grape varieties, cultivation systems, and wine regions, along with a shop, restaurant, and tasting room with panoramic views (Fig. 26). Museum Malvasia (Icod de los Vinos, Tenerife) offers an exquisite tasting experience of local Malvasia wines in a beautiful garden setting, alongside historical information on the island's wine culture. The El Grifo Wine Museum (San Bartolomé, Lanzarote) is located in the original winery building from 1775, showcasing historic machinery, old wine presses, and tools used over centuries, offering a deep dive into the evolution of winemaking in extreme volcanic conditions. Casa Museo del Vino Las Manchas (La Palma) provides a generic vision of the island's traditional viticultural heritage, with displays in multiple languages and a shop featuring a wide selection of local wines.



Figure 26. Casa del Vino de Tenerife in El Sauzal comprises the winemaking history, the presentation of grape varieties, terroirs, cultivation systems, agroecosystems (including other crops cultivated with vine), winemaking technologies, and wines of Canary Islands.

Source: photographs of Márta Kreidlmayer.

#### *Wine tourism and sustainability through circular bioeconomy*

Wine tourism in the Canary Islands has become a critical driver for sustainable rural development, providing the economic foundation needed for organic agriculture and circular bioeconomy practices. Wine tourism allows small, high-quality producers to diversify their income beyond bottle sales, supporting “multifunctional” farming that includes landscape preservation and education. Revenue from visitors helps maintain unique, labour-intensive viticultural systems like the braided cord (cordón trenzado) in Tenerife’s Orotava Valley and the volcanic pits (hoyos) of La Geria in Lanzarote. Tourism provides the financial buffer required for wineries to adopt organic and regenerative practices, which are increasingly necessary to maintain soil health and biodiversity.

Wineries are increasingly adopting circular models to reduce waste and environmental impact (Díaz et al. 2024), often showcasing these practices to tourists. The three pillars of circular bioeconomy in the Canary Islands:

- **Waste Valorisation:** Regional projects focus on converting by-products like grape pomace and lees into compost, biofertilizers, or biogas (Abbate et al. 2025).
- **Zero-Kilometre Models:** Many wineries prioritize “zero-kilometre” local consumption, which reduces carbon footprints and strengthens the local economic cluster (Sánchez-Hernández, 2024).
- **Resource Efficiency:** Leading wineries, such as Bodegas El Grifo, have been recognized in 2025 for integrating

energy efficiency and circular economy as core pillars of their tourism strategy.

#### *Challenges posed by Climate Change*

Climate change poses severe threats to Canarian viticulture through rising temperatures, drought, and extreme weather (Rochard, 2023). Mitigation and developing adaptation strategies implemented include:

- **Genetic Diversification:** Increasing focus on identifying and utilizing drought-tolerant and late-ripening cultivars to delay the phenological cycle, preventing grapes from ripening during peak summer heat (Baltazar et al. 2025; Carbonell-Bejerano et al. 2015).
- **Soil Management and Ground Covers:** implementing permanent plant covers and mulches (using straw or pruning waste) to reduce soil erosion, lower soil temperature, and significantly improve water retention (Cataldo et al. 2021).
- **Late Pruning:** Applying late pruning techniques (post-budburst) to delay budbreak by up to 2–3 weeks, protecting vines from early-season extreme weather and shifting fruit development to cooler periods.
- **Canopy and Training Adjustments:** Modifying trunk height and leaf area-to-fruit weight ratios to manage the microclimate around grape clusters, reducing heat stress and sunburn damage (Reta et al. 2025).
- **Optimized Infrastructure:** Moving away from water-intensive systems toward optimized water distribution and increased rainwater harvesting.
- **Controlled Deficit Irrigation (CDI):** Applying limited water volumes based on precise soil/plant sensors and remote sensing to maintain moderate vine stress without compromising yield or quality (Mirás-Avalos & Araujo, 2021).
- **Dryland Farming Techniques:** Utilizing traditional methods like “RF layers” (natural rock fragment accumulation) to improve infiltration, decrease runoff, and lower maximum soil temperatures (Pérez, 2016).
- **Varietal and Location Shifts:**
  - **High-Altitude Cultivation:** Moving vineyards to higher, cooler elevations to mitigate rising temperatures.
  - **Genetic Selection:** Researching and selecting drought-resistant and heat-tolerant native grape varieties and (if not ungrafted) rootstocks.
- **Deploying innovative technologies in precision viticulture,** such as the PocketDRIVE app, for real-time tracking of vine water use and soil water-holding capacity, multi-source data for deficit irrigation in vineyards (Gutiérrez et al. 2025), vineyard monitoring and using the obtained data for AI-based modelling, etc.

Events like the three-day “heroic viticulture and climate change” conference in Tenerife (October 2025) facilitate collaboration between the Canarian government and international experts to refine adaptive strategies. Discussions are ongoing to introduce more flexibility into Geographic Indication (GI) systems, allowing producers to use new varieties or cultivation techniques previously restricted by traditional laws.

## CONCLUSIONS

The Canary Islands volcanic geology, geomorphology, climate and network of microclimates and isolation from mainland viticultural areas created unique and extreme wine terroirs, which require special, mostly manual viticultural practices, well suited for organic and biodynamic production. Indeed, many wineries are certified organic or biodynamic producers.

The isolation from mainland saved the Canarian vines from the devastating phylloxera and during the 500 years long history of viticulture ancient grape varieties. This isolation has created a “time capsule” of ancient grapevine varieties, many of which are extinct elsewhere in the world. Recent studies suggest these vines harbour valuable genes for drought tolerance and disease resistance, making them essential for future climate change adaptation. Thus, these unique grape varieties may function as gene banks for viticultural research to produce climate-resilient grape varieties.

Canary Island viticulture is at a critical juncture, having lost 60% of its vineyard land since 2010 due to an aging workforce and rural depopulation. Oenotourism is currently being leveraged as a strategic “anchor” to attract and retain younger generations by modernizing the sector. Unique wine tourism in the Canary Islands is deeply rooted in its volcanic landscape and distinctive viticulture practices and rich cultural heritage offering experiences that go beyond traditional vineyard visits. The archipelago’s unique viticultural landscapes, such as the volcanic La Geria in Lanzarote and the braided cord system in Tenerife’s La Orotava Valley, are now leveraged as “landscapital”—a production asset where the landscape itself is part of the product. This intersection of “heroic” viticulture and high-value tourism is driving a transition toward a sustainable, circular bioeconomy in the vine and wine sector, integrating energy efficiency and circular practices, such as repurposing vineyard by-products into high-value resources.

Climate change poses a significant threat to viticulture in the Canary Islands, primarily through rising average temperatures, intensified heatwaves, and prolonged droughts. These factors disrupt grapevine phenology, leading to earlier ripening, higher sugar and alcohol content, and reduced acidity, which can degrade wine quality and typicality. Regional authorities and growers are implementing various strategies to ensure the sustainability of the sector, including promotion of Heroic Viticulture, agronomic adaptation strategies, water and soil management, varietal and location shifts and environmental impact reduction.

The limitations of studying the details of the viticultural agroecosystems in the Canary Islands are connected to the obstacles concerning the implementation of IT and AI-based technologies in the Canary Islands’ viticulture since it remains constrained by the region’s unique geographical and socio-economic landscape. These “heroic viticulture” sites face specific hurdles in terms of extreme terrain fragmentation, limited mechanization, microclimate complexity, economic and structural barriers, aging

workforce and knowledge gaps. There is a noted lack of technical expertise among an aging farmer population. The “steep learning curve” for digital tools, combined with a lack of intergenerational knowledge transfer, slows the adoption of new technologies.

The scientific and practical value of the Canary archipelago’s potential is the integration its unique viticultural genetic heritage with circular bioeconomy models applied in organic viticulture and landscape conservation, which has become a primary focus for sustainable development. However, as outlined above, future research is needed to enhance the integration of new viticultural technologies, competence development and knowledge transfer with the valuable traditional cultivation methods and overcome the obstacles of the extreme terroirs.

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