

## Artículos Científicos (SCI)

### **Susceptibility to Downy Mildew (*Plasmopara viticola*) of different *Vitis* genotypes**

Boso, S; Alonso-Villaverde, V.; Gago, P.; Santiago, J.L.; Martínez, M.C. (2014)  
Crop Protection 63: 26-35. DOI 10.1016/j.cropro.2014.04.018

#### Summary

The susceptibility of different varieties of *Vitis vinifera* and other *Vitis* species to downy mildew (caused by *Plasmopara viticola*) in field, greenhouse and laboratory tests was compared over a period of three years. Different degrees of susceptibility were detected. The most susceptible *V. vinifera* varieties were 'Treixadura' and 'Albariño'; 'Cabernet Sauvignon', 'Mencia' and 'Chasselas Doré' were the least susceptible. The non-vinifera varieties showed no symptoms of downy mildew in the field. Surprisingly, in laboratory and greenhouse tests, the rootstock 110-R was much more susceptible to infection than S04. No relationship was seen between susceptibility and berry colour, or the time of sprouting or fruit ripening. Neither was any correlation seen between susceptibility and the condition of being a traditional or introduced variety. Better knowledge of the susceptibility to downy mildew of different varieties would allow for growers and breeders to select those that are more resistant.

### **Works of Art and Crop History: Grapevine Varieties and the Baroque Altarpieces**

Gago, P.; Boso, S; Alonso-Villaverde, V.; Santiago, J.L.; Martínez, M.C. (2014)  
Economic Botany DOI 10.1007/s12231-014-9265-8

#### Summary

This study compares the ampelographic characterization of adult leaves and clusters from real grapevine varieties with those present in Solomonian columns of Baroque altarpieces. In a previous preliminary work, the authors concluded that sculpted grapevine leaves in Baroque altarpieces were represented with botanical accuracy and may represent real varieties. Grapevines are a very important decorative feature of these art works, in particular as ornamentation on Solomonian columns. The present work examines more of these carved leaves and includes also the clusters. Six real grapevine varieties were identified on as many altarpieces, enriching their cultural value and pointing to their existence in the wine-growing zone by the 17th century. Further varieties may be identifiable on Baroque altarpieces in other winemaking areas using the same methods. These results encourage other researchers to use unconventional sources for the study of the evolution of agriculture and crop history.

### **Comparative ampelographic and genetic analysis of grapevine cultivars from Algeria and Morocco**

Zinelabidine, L.H.; Laiadi, Z.; Benmehaia, R.; Gago, P.; Boso, S.; Santiago, J.L.; Haddioui, A.; Ibáñez, J.; Martínez-Zapater, J.M.; Martínez, M.C. (2014)  
Australian Journal of Grape and Wine Research DOI: 10.1111/ajgw.12079

#### Summary

North Africa has a long history of viticulture and a wide diversity of grape cultivars. Ampelographic studies have been made of grapevine cultivars grown all over the world, but only a few describe those of Algeria and Morocco. Many Maghrebi cultivars held in germplasm banks or found growing wild in this region have recently been subjected to microsatellite profiling by different researchers, though little comparative analysis has

been undertaken. The aim of the present work was to clarify the identity of the grapevine cultivars growing in the Maghreb via ampelographic and single-nucleotide polymorphism analysis. Seventy-one accessions were studied through the ampelographic construction of their mean leaves, via genotypic analysis using single-nucleotide polymorphism markers, and the comparison of these results with previously reported single sequence repeat marker profiles and ampelographic data for other grapevine material from the Maghreb. New synonyms and homonyms were detected between Maghrebi cultivars. Some misinterpretations and errors of identification made during the making of the studied germplasm collections were identified. This study helps clarify the confusion over the identity of Algerian and Moroccan grapevine cultivars and provides a general picture of grapevine diversity in the Maghreb.

### **Classification and characterization of different white grape juices by using a hybrid electronic tongue**

Gutiérrez-Capitán, M.; Santiago, J.L.; Vila-Planas, J.; Llobera, A.; Boso, S.; Gago, P.; Martínez, M.C.; Jiménez-Jorquera, C. (2013)

Journal of Agricultural and Food Chemistry 61(39):9325-9332 DOI: 10.1021/jf402960q

#### Summary

A multisensor system combined with multivariate analysis is applied for the characterization and classification of white grape juices. The proposed system, known as hybrid electronic tongue, consists of an array of electrochemical microsensors and a colorimetric optofluidic system. A total of 25 white grape juices representing the large variability of vines grown in the North-west Iberian Peninsula were studied. The data obtained were treated with Principal Component Analysis (PCA) and Soft Independent Modeling Class Analogy (SIMCA). The first tool was used to train the system with the reference genotypes -Albariño, Muscat à Petit Grains Blanc and Palomino- and the second to study the feasibility of the hybrid electronic tongue to distinguish between different grape juice varieties. The results show that the three reference genotypes are well differentiated in the PCA model and this can be used to interpolate the rest of varieties and predict their basic characteristics. Besides, using the SIMCA, the system demonstrates high potential for classifying and discriminating grape varieties.

### **Impact of clonal variability in *Vitis vinifera* Cabernet franc on grape composition, wine quality, leafblade stilbene content and downy mildew resistance**

van Leeuwen, C.; Roby, J.P.; Alonso-Villaverde, V.; Gindro, K. (2013)

Journal of Agricultural and Food Chemistry 61(1): 19-24. DOI: 10.1021/jf304687c

#### Summary

In this study, ten clones of *Vitis vinifera* Cabernet franc (not yet commercial) have been phenotyped on precocity, grape composition and assessment of wine quality made by micro vinification in 2008, 2009 and 2010. Additionally, two original criteria have been considered: concentration of 3-isobutyl-2-methoxypyrazine in grapes and wines (the green bell pepper flavor) and resistance of grapevines to downy mildew (*Plasmopara viticola*) by stilbene quantification upon infection. Precocity of veraison varied up to four days at veraison. Berry size and yield were

highly variable among clones. However, these variables were not correlated. Tanins and anthocyanins varied among clones in grapes and wines. Variations in grape and wine IBMP were not significant. Some clones showed lower susceptibility for downy mildew on leaves. Lower susceptibility was linked to a higher production of stilbenic phytoalexins involved in downy mildew resistance mechanisms.

#### **Evolution of flavonoids in Mouraton berries taken from both bunch halves**

Figueiredo-González, M.; Cancho-Grande, B.; Boso, S.; Santiago, J.L.; Martínez, M.C.; Simal-Gándara, J. (2013)  
Food Chemistry 138 (2-3): 1868-1877.

#### Summary

Galicia (N.W. Spain) is a Spanish region with several old-traditional winegrowing areas. There are autochthonous grapevine varieties, such as *Vitis vinifera* L. cv. Mouratón, considered a biodiversity resource in viticulture and an opportunity for Galician sustainable wine production. Therefore, it is necessary to assess the potential of traditional cultivars to produce quality red wines. In this work, anthocyanin and flavonol evolution was followed in red berries from *Vitis vinifera* L. cv. Mouratón. The novelty of this study is that grapes were separately collected from two different positions (tips and shoulders) within the cluster, over ripening to examine the effects of berry position within the fruit cluster on the flavonoid compounds. Derivatives of five anthocyanins (malvidin, peonidin, petunidin, delphinidin and cyanidin) and derivatives of six flavonols (quercetin, myricetin, kaempferol, laricitrin isorhamnetin and syringetin) were detected in both positions within the cluster. Dynamic of anthocyanins (from 819 mg/kg to 1206 mg/kg in tips; and from 786 mg/kg to 1077 mg/kg in shoulders) and dynamic of flavonols (from 25 mg/kg to 41 mg/kg in tips; and from 18 mg/kg to 21 mg/kg in shoulders) confirmed their upward trends over ripening. Grapes located inside the shoulder bunch receive less sunlight radiation than those located inside the tip bunch and this fact could explain the different accumulation observed for both positions. These results can be useful for winemakers in order to obtain different final red wine quality.

#### **Protease inhibitors decrease the resistance of Vitaceae to *Plasmopara viticola***

Gindro, K.; Berger, V.; Godard, S.; Voinesco, F.; Schnee, S.; Viret, O.; Alonso-Villaverde, V. (2012)  
Plant Physiology and Biochemistry 60: 74-80

#### Summary

*Plasmopara viticola* must successfully infect susceptible grapevine cultivars to complete its biological cycle. In resistant grapevine varieties, *P. viticola* is blocked by the activation of defense mechanisms; these defense mechanisms produce hypersensitive reactions, which are related to programmed cell death. In animals, programmed cell death is dependent on caspase activities. In plants, different caspase-like proteases assume the same functions. To examine the roles of caspase-like proteases in *P. viticola*-grapevine interactions, three varieties of grapevine with different levels of *P. viticola* resistance were chosen. These grapevine varieties were treated with either PMSE, a serine protease inhibitor, or E-64, a

cysteine protease inhibitor. The development of the pathogen was followed microscopically, and the plant defense reactions were estimated through stilbene quantification. Both protease inhibitor treatments increased the infection rate in the resistant and immune varieties, diminished the production of toxic stilbenes and changed the level of the plants' susceptibility to the pathogen. In particular, after either protease treatment, the cultivar that was originally immune became resistant (hyphae and haustoria were observed), the resistant cultivar reached the level of a susceptible cultivar (sporulation was observed) and the susceptible cultivar became more sensitive (*P. viticola* colonized the entirety of the leaf mesophyll)

### **Floral, spicy and herbaceous active odorants in Gran Negro grapes from shoulders and tips into the cluster, and comparison with Brancellao and Mouratón varieties**

Noguerol-Pato, R.; González-Barreiro, C.; Cancho-Grande, B.; Martínez, M.C.; Santiago, J.L.; Simal-Gándara J. (2012)  
Food Chemistry 135(4): 2771-2782

#### Summary

Within the framework of a more and more 18 competitive market, the opportunity to obtain different wines from the same variety cultivated in the same vineyard is becoming of increasing importance. In this study the presence of aroma compounds in Gran Negro (*Vitis vinifera* L.) grapes was investigated in order to obtain its aroma potential fingerprint taking into consideration the separation of apical (tips) and basal (shoulders) berries of the clusters. In the final stages of maturation, differences were searched in the probable alcohol content, total acidity of the must, as well as in the aromatic composition of skin and flesh from shoulder and cluster tip berries. A GC-MS method was used to determine the aromatic composition. The obtained results showed that there was variability for their aromatic composition. These results are promising for those wine cellars that are considering the separation of berries from tips and shoulders of the clusters for the elaboration of wines with different qualities. For the berries from the tips of the clusters, the main volatiles were: aromatic alcohols and volatile phenols were mainly found in the flesh (15 and 2 times higher than in skin, respectively); whereas aldehydes and C6 alcohols were mainly in the skin (4 and 3 times higher than in the flesh, respectively). For this reason, it could be recommended to separate berry skin before enzymatic maceration of the berry flesh must. For the berries from the shoulders of the clusters, the main volatiles were the group of volatile phenols showed 2 times more importance in the skin than in flesh; it could be recommended to maintain berry skin during enzymatic maceration of the must. Overall, tips showed a 40% lower level of C6 alcohols (contributing to herbaceous nuances). These results from Gran Negro were compared with those of Brancellao and Mouratón cultivars.

### **Anthocyanins and flavonols in berries from *Vitis vinifera* L. cv. Brancellao separately collected from two different positions within the cluster**

Figueiredo-González, M.; Simal-Gándara, J.; Boso, S.; Martínez, M.C.; Santiago, J.L.; Cancho-Grande, B. (2012)  
Food Chemistry 135(1): 47-56

#### Summary

Galicia (N.W. Iberian Peninsula) is a Spanish region with several old-traditional winegrowing areas. *Vitis vinifera* L. cv. Mencía is one of the most often used to produce quality red wines in the five Galicia Denomination of Origin. However, there are traditional cultivars such as Brancellao, which were not exploited for their potential to

produce quality red wines. Dynamics of anthocyanin and flavonol accumulation were studied separately in two different positions within the cluster (tips and shoulders), during 30 days before harvest. The objective of separating berries is to assess the existence of different polyphenol quality in both positions; as a consequence, the selection and harvest of those berries with a higher content of anthocyanins and flavonols could produce red wines with different qualities. Derivatives of five anthocyanins (malvidin, peonidin, petunidin, delphinidin and cyanidin) were detected in skins at both positions within the cluster. Anthocyanin contents stabilized in the 30 days prior to harvest in the berries from the shoulders whereas they continue to increase in those from the tips. Derivatives of six flavonols (quercetin, myricetin, kaempferol, laricitrin, isorhamnetin and syringetin) were detected in skin and flesh at both positions within the cluster. Dynamics of anthocyanins (from 400 to 515 mg/kg in tips; and from 598 to 574 mg/kg in shoulders) and flavonols (from 19 to 29.3 mg/kg in tips; and from 22.7 to 29.4 mg/kg in shoulders) over ripening confirmed that these polyphenols presented upward trends. Therefore, it is not necessary to harvest Brancellao berries separately and a high quality red wine will be obtained with berries from entire clusters regarding these compounds.

#### **Quantification of stilbenes in *Vitis* genotypes with different levels of resistance to *Plasmopara viticola* infections**

Boso, S.; Alonso-Villaverde, V.; Martínez, M.C.; Kassemeyer, H-H.; Gindro, K. (2012) American Journal of Enology and Viticulture 63(3): 419-423.

#### Summary

Stilbenic phytoalexins have been associated with disease resistance. In *Vitis* spp., stilbene synthesis can be induced by UV irradiation, treatment with a variety of substances extracts, and inoculation with *Botrytis cinerea* or *Plasmopara viticola*. The aim of the present work was to examine the relationship between stilbene production and the level of resistance of different *Vitis* genotypes to *P. viticola*. The ability of different grapevine genotypes (*Vitis vinifera* L. cvs. Tempranillo, Touriga Nacional, Pinot Noir and Cabernet Sauvignon, and the non-vinifera *Vitis riparia*) to resist *Plasmopara viticola* infection was assessed via their potential to accumulate toxic stilbenic phytoalexins. Leaf discs taken from plants belonging to these genotypes were inoculated with *P. viticola* sporangia and disease severity determined 5 days later. Stilbene production was quantified in similar leaf material at 6, 24, 48, and 72 h post inoculation (hpi). After *P. viticola* infection, the resistant genotype *V. riparia* showed high production of the phytotoxic stilbenes  $\epsilon$ - and  $\delta$ -viniferin, which limited the development of the pathogen and prevented it from producing spores. Indeed, this genotype was associated with the lowest sporulation values. No relationship was observed, however, between resistance and these compounds in the *V. vinifera* genotypes. Further study is required to define the role of stilbenic phytoalexins in resistance to *P. viticola*.

#### **Flavonoids in Gran Negro berries collected from shoulders and tips within the cluster, and comparison with Brancellao and Mouratón varieties**

Figueiredo-González, M.; Simal-Gándara, J.; Boso, S.; Martínez, M.C.; Santiago, J.L.; Cancho-Grande, B. (2012) Food Chemistry (2012), doi: 10.1016/j.foodchem.2012.01.095

#### Summary

Galicia (the north-western corner of Spain) is a Spanish region with several old-traditional winegrowing areas. *Vitis vinifera* L. cv. Mencía is one of the most often used to produce quality red wines but the tendency of the world wine-making market is to reward the production of wines that have particular and differentiated characteristics. In Galicia, there are other red cultivars such as Gran Negro which were not exploited for their potential to produce quality red wines. Dynamics of anthocyanin and flavonol accumulation in Gran Negro berries were studied separately in two different positions within the cluster (tips and shoulders) during thirty days before harvest to assess the existence of different polyphenol quality in both positions and as a consequence, red wines with different qualities. Dynamics of anthocyanins over ripening confirmed that anthocyanins presented upward trends (from 1510 to 1727 mg/Kg in tips; and from 1532 to 1728 mg/Kg in shoulders) but dynamics of flavonols confirmed that maximum values were reached and stabilized thirty days before harvest (from 45 to 39 mg/Kg in tips; and from 49 to 45 mg/Kg in shoulders). No differences were observed in anthocyanin and flavonol contents collected from tips and shoulders which indicates that is not necessary to harvest them separately. The results from Gran Negro were compared with those of Brancellao and Mouratón.

#### **Active odorants in Mouratón grapes from shoulders and tips into the bunch**

Noguerol-Pato, R.; González-Barreiro, C.; Simal-Gándara, J.; Martínez, M.C.; Santiago, J.L.; Cancho-Grande, B. (2012).

Food Chemistry (2012), doi: 10.1016/j.foodchem.2012.01.113

#### Summary

The opportunity for obtaining different wines from the same variety cultivated in the same vineyard is becoming of increasing importance. This is why some wine cellars have started to assay the separation of the tips and shoulders berries of the clusters of a specific variety with this objective. In this work, the study is focused on berries of Mouratón (*Vitis vinifera* L.) to investigate if, in the latter stages of ripening, differences exist in the probable alcoholic degree, total acidity of the must, as well as in the aromatic composition of skin and flesh of berries coming from the tips and shoulders of the clusters. Gas chromatography coupled to mass spectrometry (GC-MS) was used to determine the aromatic composition. The obtained results showed that there was not variability for the probable alcoholic degree and total acidity between the tips and shoulders, whereas there was variability for their aromatic composition during ripening. These results are promising for those wine cellars that are considering the separation of berries from tips and shoulders of the clusters for the elaboration of different quality wines.

#### **Susceptibility to downy mildew in grape clusters: New microscopical and biochemical insights.**

Gindro, K.; Alonso-Villaverde, V.; Voinesco, F.; Spring, J.L.; Viret, O.; Dubuis, P.H. (2012)

Plant Physiology and Biochemistry: 52: 140-146. doi:10.1016/j.plaphy.2011.12.009

#### Summary

Grape clusters of different *Vitis* genotypes, including *Vitis vinifera* cvs Chasselas and Merlot, and two interspecific grape varieties, Solaris (cvs. Merzling\* x (Saperavi severneyi x Muscat ottonel)) and 2091 (cvs. Gamaret x Bronner), are susceptible or resistant to downy mildew. These cultivars were inoculated with *Plasmopara viticola* at three developmental stages (BBCH stages 53, 69 and 75). Samples were examined by scanning electron microscopy and the synthesis of stilbenes was measured. Microscopical examinations of pedicels, rachis and calyptras showed important differences in stomatal structures within seasonal development. At BBCH 53, successful infections were observed on all tested cultivars and functional stomata were present, while no infections were observed after this stage. At BBCH 69 and 75, cracks were observed around the stomata and guard cells were unstructured or completely collapsed, leading to closed-like stomata. At BBCH 53, significant stilbene accumulation was quantified in 2091 and Solaris; pterostilbene and  $\delta$ -viniferin were produced in large amounts. In the susceptible varieties, only piceid and resveratrol were induced. At the other two stages, the concentration of all measured stilbenes was undetectable. The critical roles of seasonal development and stilbenes in the resistance of grape clusters towards downy mildew are discussed.

### **Aroma potential of Brancellao grapes from different cluster positions**

Noguerol-Pato, R.; González-Barreiro, C.; Cancho-Grande, B.; Santiago, J.L.; Martínez, M.C.; Simal-Gándara, J. (2012).

Food Chemistry: 132: 112-124. doi:10.1016/j.foodchem.2011.10.042

#### Summary

In this study the presence of aroma compounds in grapes of Brancellao (*Vitis vinifera* L.) was investigated in order to obtain its aroma potential fingerprint. It is well known that differences exist in aromatic compounds amongst grapevine varieties at ripening stages. Within the framework of an increasingly competitive market, the chance of obtaining different wines from vines of the same variety grown at the same vineyard is becoming of increasing importance. This can be done through the managing of the vineyard, but also some wineries have assayed the separation of the tip and shoulder berries of the clusters of a specific variety with this objective. In this work it is evaluated that, in the final stages of maturation, differences exist in the probable alcoholic degree, total acidity of the must, as well as in the aromatic composition of skin and flesh of berries coming from the tips and shoulders of the clusters. Gas chromatography coupled to mass spectrometry (GC-MS) was used to determine the aromatic composition, in the skin and flesh of each sample, either tip or shoulder berries from the clusters. The obtained results showed that there was not variability for the probable alcoholic degree and total acidity between the shoulders and tips, whereas there was variability for their aromatic composition. For the berries from the tips of the clusters most of volatiles were found in the flesh (except aldehydes) and spicy and floral nuances (with the only exception of  $\beta$ -ionone) were in higher proportions. For the berries from the shoulders of the clusters, most of volatiles were found in the skin (monoterpenes, norisoprenoids, aldehydes, and C<sub>6</sub> alcohols), where the flesh was slightly richer in aromatic alcohols, volatile phenols and pantolactone;  $\beta$ -ionone and herbaceous nuances were in higher proportions. These results are promising for those wineries that are considering the chance of separating berries from tips and shoulders of the clusters for the elaboration of different quality wines.

## **Influence of locally selected yeast on the chemical and sensorial properties of Albariño white wines**

Carrascosa, A. V., Bartolome, B., Robredo, S., Leon, A., Cebollero, E., Juega, M., Nunez, Y.P., Martinez, M. C., Martinez-Rodriguez, A.J. (2012)

LWT-Food Science and Technology 46(1): 319-325.

doi: 10.1016/j.lwt.2011.09.011

### **Summary**

The use of selected yeast strains with improved or novel properties may promote wines with special and original quality attributes. In this paper, changes in the chemical composition (aroma compounds and polyphenols) and sensorial properties of Albariño white wines elaborated with the same must and selected yeast (named as 1, 2 and 3) have been studied in comparison with wines subjected to non-inoculated fermentation (control wine). The results indicated that yeast strain can significantly influence the aroma and polyphenol composition of the wines. Wines elaborated with strain 1 had a higher concentration of terpenes and norisoprenoids, which are compounds closely associated with the fruity and fresh character of Albariño white wines. These same wines had a lower concentration of flavan-3-ols, closely associated with the astringency and bitterness of the wine and the lowest browning potential. The formal sensory analysis conducted by 8 trained judges showed that wines elaborated with strain 1 were preferred by the tasting panel. Therefore, the selection of yeast strains could offer the possibility to modulate sensorial attributes related with the aroma and phenol composition in Albariño white wines.

## **Identity of three grapevine varieties from a rediscovered viticulture region in Northwest Spain**

Gago, P.; Santiago, J.L; Boso, S; Alonso-Villaverde, V.; Orriols, I.; Martínez, MC. (2011)

Journal International des Sciences de la Vigne et du Vin 45(4): 245-254

### **Summary**

The old literature contains references to the varieties once cultivated in the Betanzos region (northwestern Spain) and three of them (Blanco Legítimo, Agudelo and Serradelo) were rediscovered during a survey work that began in 1987 and now form part of a collection held at the Misión Biológica de Galicia (MBG-CSIC). The aims of the present work were 1) to describe these three varieties, 2) to determine whether grapevines recently planted are indeed true representatives of these varieties and if so 3) to examine their agronomic and oenological potential. Ampelographic descriptions were made following the OIV method (OIV, 2009) and the reconstruction of 'mean leaves' (Martínez and Grenan, 1999). Ten microsatellite loci were also characterised. Having confirmed the supposed identity of the vines in the vineyards, their agronomic and oenological potentials in the region were investigated (fertility, weight of fruit, composition of must and wine). The ampelographic and molecular results showed the following synonyms: Blanco Legítimo = Albarín Blanco; Serradelo = Brancellao (Spain) or synonym Alvarelhão (Portugal); Agudelo = Chenin Blanc. The vines supposed to be Blanco Legítimo and Agudelo recently planted in the Betanzos area had largely been correctly identified by their planters. The identification of synonyms has repercussions for the commercial exploitation of these varieties. The implications for Blanco Legítimo are relatively reduced since its synonyms are also grown in minority areas; however, for Serradelo and Agudelo they are more serious because their



synonyms are varieties already widely grown. Finally, the present results contribute to our knowledge of the history and movement of grapevine cultivars in Europe.

### **Leaf thickness and structure of *Vitis vinifera* L. Cv. Albariño clones and its possible relation with susceptibility to downy mildew (*Plasmopara viticola*) infection**

Alonso-Villaverde, V.; Boso, S.; Santiago, J.L.; Gago, P.; Rodríguez-García, M.I.; Martínez, M.C. (2011).

Journal International des Sciences de la Vigne et du Vin 45(3): 161-169

#### Summary

The grapevine (*Vitis vinifera* L.) cultivar Albariño is currently the most economically important in Galicia (northwestern Spain). Earlier works assessing the natural susceptibility to downy mildew leaf infection (both in the laboratory and in the field), carried out in the collection of Albariño clones at the Misión Biológica de Galicia (CSIC), showed great differences among the clones (Boso et al., 2004b, 2005b, 2006; Boso and Kassemeyer, 2008). The aim of the present work is to highlight the histological differences in leaves, in particular thickness and structure, among the 11 different Albariño clones and to find out their possible relation with their natural susceptibility to *Plasmopara viticola*. Transverse sections of adult leaves were prepared and observed under light microscope. The area corresponding to the different leaf layers was measured. The results showed significant differences between the clones regarding the thickness of the spongy mesophyll. The clones CSIC-4 and CSIC-1 had the thickest spongy mesophyll (average mean = 14316.8  $\mu\text{m}^2$ ) whereas CSIC-3 showed the thinnest one (11548.1  $\mu\text{m}^2$ ). The CSIC-3 clone, one of the least susceptible clones to *P. viticola* in previous studies, showed the thinnest and most compact spongy mesophyll. On the contrary, the CSIC-1 clone had the thickest spongy mesophyll and was also one of the most susceptible to this pathogen. Therefore, it could be possible to relate their histological leaf characteristics with their different levels of natural susceptibility to *P. viticola*. This work contributes to the understanding of the link between histological characteristics of leaf layers and mesophyll cells and the different natural susceptibility of grapevines to downy mildew. This may become in the future a valid tool to be used during clonal selections in grapevine breeding programs.

### **Pattern recognition of three *Vitis vinifera* L. red grapes varieties based on anthocyanin and flavonol profiles, with correlations between their biosynthesis pathways**

M. Figueiredo-González; E. Martínez-Carballo; B. Cancho-Grande; J.L. Santiago; M.C. Martínez; J. Simal-Gándara (2012).

Food Chemistry: 130: 9-19

#### Summary

The presence of anthocyanins and flavonols in three selected red grape varieties was investigated, in order to use their polyphenolic characterisation as a fingerprint. Berry skins of Gran Negro grapes were characterised by the presence of high content of malvidin- and peonidin-3-*O*-glucoside; Mouratón grapes, by the presence of high content of petunidin- and delphinidin-3-*O*-glucoside; and Brancellao grapes, by the presence of high content of cyanidin-3-*O*-glucoside. The main flavonols found included the 3-*O*-glucosides of quercetin, myricetin, kaempferol, laricitrin, isorhamnetin and syringetin. Using cluster analysis and principal components analysis, Gran Negro could be characterised by their content of isorhamnetin-3-*O*-glucoside and syringetin-3-*O*-glucoside and, along with Mouratón, by their myricetin conjugates. Flavonol profile

could not provide a fingerprint of Brancellao variety. Stepwise discriminant analysis was performed in order to find the polyphenolic compounds, which characterised the selected grape varieties. Finally, anthocyanin and flavonol profiles in red grapes were compared and results confirmed that biosynthesis of flavonols is closely related to that of anthocyanins.

### **Downy mildew: is resistance linked to inoculum concentration?**

V. Alonso-Villaverde, O. Viret, K. Gindro (2011)

Vitis 50(3): 127-129

#### Summary

Leaves of different *Vitis vinifera* cultivars, susceptible ('Chasselas' and '2185'), less susceptible ('2142') or resistant to downy mildew ('Solaris' and '2091'), were inoculated with four different concentrations of an aqueous sporangia suspension of *Plasmopara viticola* ( $5 \times 10^5$ ,  $2 \times 10^5$ ,  $6 \times 10^4$  and  $2 \times 10^4$  sporangia·ml<sup>-1</sup>). The infection rate of these samples was then examined by light microscopy and synthesis of stilbenes was analysed at infection sites. Infection rate increased parallel with inoculum concentration, but there was no correlation between the infection rate and resistance to *P. viticola*. Moreover, at the lowest inoculum concentration, the infection rate is similar for susceptible and resistant grapevine varieties. Quantification of stilbenes at 72 hpi showed that at the lowest inoculum concentration, the most susceptible grape variety synthesized the largest amount of stilbenes, whose level remained however below the ED50 values defined for each of them. Conversely, at the highest inoculum concentration, the most resistant varieties produced the highest amounts of the most toxic stilbenes against *P. viticola*. The critical role of the inoculum concentration used for artificial inoculation to evaluate grapevine resistance to downy mildew is discussed.

### **Susceptibility of 44 grapevine (*Vitis vinifera* L.) varieties to downy mildew in the field**

S. Boso, V. Alonso-Villaverde, P. Gago, J.L. Santiago, M.C. Martínez (2011)

Australian Journal of Grape and Wine Research: 17(3): 394-400

#### Summary

Downy mildew, which occurs worldwide, is one of the most destructive of all grapevine diseases. Several authors have examined the host–pathogen interaction in different *Vitis* species, crosses and hybrids, but only a few studies comparing this in true *V. vinifera* varieties have been undertaken. The aim of the present study was to examine the in-field susceptibility to infection by *Plasmopara viticola*, the causal agent of downy mildew, of 44 grapevine varieties, all belonging to the collection of the Misión Biológica de Galicia. Over a period of 2 years, the incidence and severity of downy mildew on the leaves and clusters of all 44 varieties was determined using a visual scale. Some of those examined showed high susceptibility (Chenin Blanc, Albariño and Prieto Picudo),

others showed low susceptibility (Silveiriña, Caiño Bravo, Follajeiro and Brancellao Blanco, and still others showed intermediate susceptibility. Some varieties showed high disease incidence but low disease severity and vice versa. No significant correlation was detected between disease incidence and severity in either leaves or clusters, nor indeed between leaves and clusters. Neither berry colour, cluster compactness nor any other studied variable bore any clear relationship with susceptibility. The different grapevine varieties examined showed great variation in terms of their susceptibility to downy mildew. The susceptibility of most varieties was the same in both study years. The results of this work could help provide new material that might be of use in grapevine genetic improvement programs, and in the study of resistance to downy mildew. The selection of old varieties from the Iberian northwest may contribute towards the growth of organic viticulture in this area and even other winemaking regions around the world.

### **Grapevine European Catalogue: Towards a Comprehensive List**

T. Lacombe; L. Audeguin; M. Boselli; B. Bucchetti; F. Cabello; P. Chatelet; M. Crespan; C. D. Onofrio; J. Eiras-Dias; S. Ercisli; M. Gardiman; M.S. Grando; I. Imazio; O. andurova; A. Jung; E. Kiss; P. Kozma; E. Maul; D. Maghradze; M. C. Martinez; G. Muñoz; J.K. Pátkova; I. Pejic; E. Peterlunger; D. Pitsoli; D. Preiner; S. Raimondi; F. Regner; G. Savin; S. Savvides; A. Schneider; J.L. Spring; A. Szoke; A. Veres; J. M. Boursiquot; R. Bacilieri; P. This (2011).  
Vitis 50(2): 65-68

#### Summary

The present attempt to establish a comprehensive and harmonized list of grapevine varieties authorized in Europe represents the contribution of the group of experts within the project GrapeGen06. In no case is this work intended to substitute for administrative initiatives in progress and has the sole aim to make available to professionals a usable document. To the involved people, the list presented here is a tool that will facilitate the implementation of the European regulations on grapevine. It also offers a panorama of the European grapevine genetic potential, thus enabling to specify whose responsibilities are involved and how much efforts should be produced to plan a sound genetic resources protection and further breeding. In this respect it is worth to underline the fact that over half of the varieties are registered in only one Member State. This opens new perspectives emphasizing the importance of European inter-institute cooperation for sharing conservation and breeding responsibilities. Considering the natural evolution of the national catalogues of grape varieties in each Member State and the progress in grape variety identification, it would be necessary to consider an annual update of this European harmonized catalogue.

The compilation of 24 national catalogues (among which 19 Member States of EU) is presented in the 95 form of 6 .pdf documents available on the following website:

[http://www1.montpellier.inra.fr/grapegen06/page\\_results/EU-catalogue.php](http://www1.montpellier.inra.fr/grapegen06/page_results/EU-catalogue.php)

### **Variability at the electron microscopic level in leaves of members of the genus *Vitis***

S. Boso, P. Gago, V. Alonso-Villaverde, J.L. Santiago, J. Méndez, I. Pazos, M.C. Martínez (2011).

Scientia Horticulturae 128, 228-238

#### Resumen

Se estudiaron las características de la superficie foliar (haz y envés), de 12 viníferas (Albariño, Treixadura, Caíño Blanco, Mencía, Chasselas, Cabernet Sauvignon, Alicante Bouschet, Godello, Torrontés, Blanco Legítimo, Caíño Tinto) y de 3 no-viníferas (110-Ritcher, SO4, Jacquez) mediante microscopio electrónico de barrido (Scanning Electron Microscopy SEM). Todas las variedades se encontraban plantadas en la misma parcela, las cepas tenían la misma edad y todas ellas estaban sometidas a idéntico sistema de poda y manejo de cultivo. Las hojas objeto de estudio en todos los casos pertenecían al nudo 8 de un pámpano fructífero que crecía en madera del año. Para cada variedad se seleccionó la misma porción de hoja, comprendida entre el nervio central y el primer nervio lateral derecho. A través de SEM (200x, 655x, 2000x), se observó su morfología en la parte adaxial (haz) y abaxial (envés), se realizaron diferentes fotografías y dibujos y se tomó nota de las diferencias encontradas. Los resultados mostraron diferencias entre la parte adaxial y abaxial, dentro de una misma variedad y entre ellas. La parte adaxial fue muy similar entre todas las variedades estudiadas, mientras que la abaxial fue diferente entre los diferentes genotipos estudiados.

#### Summary

Scanning electron microscopy (SEM) was used to examine the characteristics of the upper and lower sides of leaves belonging to members of the genus *Vitis* – 11 vinifera varieties ('Albariño', 'Treixadura', 'Caíño Blanco', 'Mencía', 'Chasselas', 'Cabernet Sauvignon', 'Alicante Bouschet', 'Godello', 'Torrontés', 'Blanco Legítimo' and 'Caíño Tinto') and three non-vinifera varieties ('110-Ritcher', 'SO4' and 'Jacquez'). All the genotypes studied grew in the same plot, were of the same age, and had been raised following the same cultivation practices. The leaves examined were taken from node 8 of a fruiting shoot growing from the previous year's wood. The same part of the leaf – the area between the main vein and the first right lateral vein – was examined in all plants. SEM observations were made at 200×, 655× and 2000×. Photomicrographs and drawings were prepared reflecting the observed morphology of the upper and lower leaf surfaces. Variables such as cell density, cell surface area (in the horizontal plane) and stomatal density and surface area (in the horizontal plane) were measured for both leaf surfaces, and intra- and intervarietal differences recorded. The upper leaf surfaces of all the studied genotypes were similar, but clear differences were recorded for the lower sides.

### **The effectiveness of stilbenes in resistant *Vitaceae*: Ultrastructural and biochemical events during *Plasmopara viticola* infection process**

Alonso-Villaverde, V.; Voinesco, F.; Viret, O.; Spring, J.-L.; Gindro, K. (2011).

Plant Physiology and Biochemistry 49, 265-274

#### Summary

Leaves of different *Vitis vinifera* L. cultivars, susceptible or resistant to downy mildew, Chasselas, Solaris, IRAC 2091 (cvs. Gamaret x Bronner) and *Muscadinia rotundifolia* were inoculated with *Plasmopara viticola*. Samples were then examined by scanning

and transmission electron microscopy, by light microscopy and for their ability to synthesise stilbenes. These phytoalexins were strictly analysed at infection sites. In the susceptible Chasselas, *P. viticola* colonises, at 72 h post-infection (hpi), all of the spongy mesophyll with functional haustoria and produces mainly the non toxic piceide. No necrotic zone was observed on Chasselas leaves. The ultrastructural response to downy mildew infection is different in each of the other three resistant grape cultivars. In Solaris, where leaf necrosis are rapidly induced, the infection is restricted to the upper part of the loose spongy mesophyll, and associated with a rapid cell wall disruption and the dispersion of cytoplasmic content along with the production of viniferins. In IRAC 2091, leaf necrosis are quite similar to those observed on Solaris but the infected plant cell, as well as the haustoria, show high electron dense cellular particles without any recognisable organelles, probably related to the effect of the toxic compound pterostilbene, which is synthesised in this grape cultivar. In *M. rotundifolia* leaf necrosis are much more scarce and smaller than in other cultivars, but pathogen and plant cells are both strongly affected, with concomitant expulsion of cytoplasmic materials through the stomata after *P. viticola* penetration. In this cultivar, the concentration of all identified stilbenes exceeds 1 \_ 103 mmol mg<sup>-1</sup> FW. The critical role of stilbenes in the resistance of *Vitis spp.* is discussed.

### **Variability in number of Stomata among Albariño (*Vitis vinifera* L.) Clones and Its Relationship with Susceptibility to Downy Mildew**

Alonso-villaverde, V.; Boso, S; Santiago, J.L.; Gago, P.; Rodríguez-garcía, M.I.; Martínez, M.C.(2011).  
*Vitis* 50(1), 45-46

#### Resumen

Durante tres campañas consecutivas se estudiaron 8 clones diferentes de la variedad Albariño (*Vitis vinifera* L.) para determinar si podía haber diferencias entre ellos en cuanto al número y tamaño de los estomas y su posible relación con la diferente susceptibilidad a *P. viticola* mostrada por estos mismos clones en estudios de campo. Considerando que los estomas representan la principal vía de entrada para este patógeno, los resultados de este trabajo sugieren una relación entre el número de estomas y la susceptibilidad a Mildiu más que con el tamaño de los estomas. Parece existir por tanto un claro efecto de la frecuencia de los estomas, aunque esta correlación no se manifestó siempre y no es el único factor implicado en la susceptibilidad a este patógeno.

#### Summary

Eight different clones of 'Albariño' (*Vitis vinifera* L.) were studied during three consecutive years to determine whether they differ in terms of their number and size of stomata and its possible relation with the different susceptibility to *P. viticola* of these same clones. Considering that stomata represent the main entrance for the pathogen the results of this work hint a relationship between stomata number and downy mildew susceptibility rather than with stomata size. Although this correlation was not always given and this is not the only factor that influences in the susceptibility to this pathogen, an apparent effect of the stomata frequency seems to exist.

### **Macro and microscopic characteristics of six vine genotypes (*spp. Vitis*) with different susceptibility to Downy Mildew**

Boso, S; Alonso-villaverde, V.; Santiago, J.L.; Gago, P.; Kassemeyer, H-H; Martínez, M.C (2010).

Vitis 49(1), 43-50

#### Resumen

Se estudió la morfología foliar en 5 genotipos de vid pertenecientes a *Vitis vinifera*, y uno de la *spp. Vitis riparia*. Estudios previos, demostraron la existencia de diferentes niveles de susceptibilidad a Mildiu (*Plasmopara viticola*). El objetivo fue comprobar si existen diferencias en hoja a nivel macro y microscópico entre estos genotipos, que pudiese tener alguna relación con la susceptibilidad a Mildiu. Se observaron diferencias macroscópicas entre los diferentes genotipos en relación a la morfología de la hoja. Los estudios microscópicos también mostraron diferencias en cuanto al índice estomático en el envés de la hoja, a la densidad de pelos, en el grosor de limbo y en la morfología y grosor del parénquima en empalizada y lagunar. Se comprobó que las dos variedades que en estudios anteriores se mostraron como las menos susceptibles a Mildiu, fueron las más similares en cuanto a las características de su parénquima lagunar y ambas presentaban ausencia o una proporción muy baja de ceras en su parte abaxial.

#### Summary

This work reports the leaf morphology of six grapevine genotypes, five belonging to *Vitis vinifera* and one to *Vitis riparia*. Earlier studies on these genotypes showed different levels of susceptibility to grapevine downy mildew (*Plasmopara viticola*). The aim of this work was to detect differences between the leaf morphology of these cultivars at the macro- and microscopic levels, and to characterize morphological traits which could be associated with susceptibility and resistance to downy mildew. An ampelographic description of each genotype was used to develop a scheme illustrating the characteristic leaf morphology. The density and morphology of the trichomes and the stomatal index was assessed by means of microscopical techniques. Distinct macro and microscope differences among the genotypes were seen. No clear relation between ampelographic characteristics and susceptibility to downy mildew was observed. The two cultivars that in earlier studies were found to be the least susceptible to downy mildew were the most similar in terms of their spongy mesophyll. Both showed very little or no wax on the abaxial surface of their leaves.

### **Biodiversity of *Vitis vinifera* L. in North-West Iberian Peninsula. Characterization of 22 old grapevine varieties.**

Gago, P.; Santiago, J.L.; Boso, S; Alonso-Villaverde, V.; Grando, S.; Martínez, M.C. (2009)

American Journal of Enology and Viticultura 60 (3), 293-301

#### Summary

Modern viticulture practises with vineyards planted to only one cultivar act on the loss of grapevine diversity. The special geographic conditions in Northern and Northwestern Iberian Peninsula make this region as a refuge area where grapevine diversity is still high. The preservation of old traditional varieties reduces the genetic erosion and allows the obtention of different and more competitive wines. A total of 22 old grapevine cultivars growing since 1993 at the grapevine collection located at Misión Biológica de

Galicia research station (CSIC), Spain, are described in this work. The phenotypic and genetic variability have been evaluated through the ampelographic characteristics of the adult leaves and the analysis of 10 microsatellite markers (VVS2, VVMD5, VVMD7, VVMD25, VVMD27, VVMD28, VVMD31, VVMD32, VrZAG62 and VrZAG79). Describing these ancient varieties, some of which have not been described to date, and resolving the problem of synonyms and homonyms are necessary steps in their recovery.

#### **Old grapevine varieties reflected in works of art; a preliminary study.**

Gago, P.; Santiago, J.L.; Boso, S.; Alonso-villaverde, V.; Martínez, M.C. (2009). *Economic Botany* 63(1), 67-77.

#### Summary

The northwest of the Iberian Peninsula is home to a number of ancient grapevine varieties now in danger of extinction, regarding which the literature contains only a few references, dating from the 19th century. In this region, baroque religious art, which is commonly ornamented with grapevine motifs, achieved great importance. This work reports the ampelographic comparison of the leaves of 19 old grapevine varieties from this region with those represented on 42 baroque altarpieces. Many of the latter were found to be ampelographically correct representations of grapevine leaves; in some cases they showed such similarity to these old varieties that their cultivation at the time when the corresponding sculptures were made can be confirmed. A larger study may therefore help determine when other varieties were cultivated in the past.ç

#### **Identification of and relationships among a number of *teinturier* grapevines that expanded across Europe in the early 20th century**

Santiago, J.L.; González, I.; Gago, P.; Boso, S.; Alonso-villaverde, V.; Martínez, M.C. (2008).

*Australian Journal of Viticulture and Wine Research* 14(3), 223-229.

#### Summary

The arrival in Europe of mildew, powdery mildew and phylloxera at the end of the 19th century led to great interest in the search for grapevine varieties less sensitive to these diseases, but which still produced large numbers of good quality grapes. Much effort was invested in trying to produce new varieties through crossing those already known, and many trials were performed to determine how varieties linked to certain vine growing regions would behave in new areas. Standing out among the latter was a small group of *teinturier* vines that were once much appreciated for the colour their grapes brought to wines. The movement of vines between one area and another was quite intense between the beginning and middle of the 20th century, and in many cases the original names of varieties were substituted by local names. The *Misión Biológica de Galicia* (CSIC) conserves a small number of *teinturier* grapevine varieties that were collected from different vine-growing areas of northern and northwestern Spain. The ampelographic characterisation of their leaves and the use of molecular markers (simple sequence repeats) allowed some of these varieties to be identified, the existence of a number of synonyms to be established, and the relationships between some of these grapevines to be recognised.

**Contribution of some grape-derived aromatic compounds to the primary aroma in red wines from cv. Caiño Tinto, cv. Caiño Bravo and cv. Caiño Longo grapes.**

Vilanova M; Cortes S; Santiago JL; Martinez C y Fernandez E. (2008).

Journal of Agricultural Science 146: 325-332

Summary

The free volatile compounds of two successive vintages of cv. Caiño Tinto, Caiño Bravo and Caiño Longo red wines, together with the volatile compounds released after the enzymatic hydrolysis of their glycosidically bound forms, were identified and quantified by gas chromatography using a flame ionization detector (GC/FID). All these wines possessed the same free volatile compounds; Caiño Longo wines showed the highest concentrations and Caiño Tinto wines the lowest. In all cases, the release of the bound forms of these compounds may contribute to the final aroma, from both a qualitative standpoint (with the appearance of free 4-terpineol, nerol and geraniol) and quantitative standpoint (notable increases were recorded for most of the compounds detected). The principal component analysis (PCA) showed a good separation of the different wine cultivars and vintages. Caiño Tinto wines were more homogeneous between vintages than the others.

**The influence of 110-Ritcher and SO4 rootstocks on the performance of scions of *Vitis vinifera* L. cv. Albariño clones.**

Boso, S.; Santiago, J.L.; Martínez, M.C. (2008).

Spanish Journal of Agricultural Research 6(1): 96-104

Summary

The use of rootstocks is widespread in modern viticulture; non-grafted *Vitis vinifera* vines are now grown in only a handful of places with very specific conditions. Since the need to graft vine-scions onto American rootstocks, a lot of work has been performed in which different aspects of the relationship between the vine and the rootstock have been studied. Despite this there are still many open questions, which remained unanswered. The present paper reports a study performed on five 'Albariño' clones MBG-1, MBG-2, MBG-7, MBG-9 and MBG-10), in which the influence of rootstock type (110-R and SO4) on a number of agronomic variables was examined. The results show that these rootstocks have no influence on many of the variables which were studied (phenology, cluster size and weight, fertility, yield, and berry size and weight), although they do influence variables such as the probable alcohol content, the quantity of free-run juice, must total acidity and weight of pruned wood. Therefore it is possible to conclude, that rootstocks influence agronomic parameters.

**A contribution to the maintenance of grapevine diversity: the rescue of Tinta Castañal (*Vitis vinifera* L.), a variety on the edge of extinction.**

Santiago, J.L.; Boso, S; Gago, P.; Alonso-villaverde, V.; Martínez, M.C. (2008).

Scientia Horticulturae 116: 199-204

Summary

The arrival of powdery mildew, phylloxera, and then downy mildew from America in the late 19th/early 20th century, was one of the most important causes of the loss of grapevine diversity in Europe. Many varieties traditionally grown in small winemaking



areas of Europe were substituted by direct producing hybrids or by a small number of varieties from other vine-growing areas. For geographic, economic, sociological, and cultural reasons, the north and northwest of Spain acts as a kind of refuge area where grapevine diversity is still high. At the Misión Biológica de Galicia (CSIC) research station a collection of living vines with a number of dispersed individuals belonging to old varieties was established in 1992. Many of these varieties had practically disappeared from vineyards and the majority existed only as centuries-old individuals. Tinta Castañal, was known until the early 20th century as one of the most highly regarded by viticulturalists and one of the most widely cultivated varieties on the Spanish side of the River Miño (which forms part of the Spanish–Portuguese border). Officially, this variety does not exist, it is not included in the Spanish List of Commercial Vine Varieties and therefore, it can neither be cultivated nor its wine marketed. The present work describes for the first time Tinta Castañal with morphological, agronomic and phenological descriptors over three consecutive years. Molecular analysis of six loci microsatellite commonly used in grapevine characterisation is also presented. The results obtained allow this variety to be compared with those of neighbouring areas (Portuguese regions) and with others further afield and demonstrate this variety to be different from any other previously described. The present description provides the data for pursuing the necessary steps to legalise this variety and contribute to the maintenance of vine biodiversity.

#### **Aromatic compounds in wines produced during fermentation: Effect of three red cultivars**

Vilanova M; Cortes S; Santiago JL; Martinez C y Fernandez E. (2007)  
International Journal of Food Properties 10(4): 867-875

##### Summary

The aromatic compounds produced during the fermentation of the red grape cultivars Caiño Tinto, Caiño Longo, and Caiño Bravo were analysed by gas chromatography (FID) on the wines of 2002 and 2003 vintages. In both years, significant differences ( $p < 0.001$ ) were observed between the wines with respect to the concentrations of aromatic compounds. Caiño Longo wines had the highest concentrations of acetates and esters. The concentrations of ethyl ester and acetates in Caiño Bravo wines were comparatively very low. Principal components analysis confirmed these results: the wines made from the different cultivars and the vintages were clearly different.

#### **Molecular and Ampelographic characterization of *Vitis vinifera* L. cvs. Albariño-Savagnin blanc and Caiño blanco shows that they are different cultivars.**

Santiago, J.L.; Gago, P.; Boso, S; Alonso-villaverde, V.; Martínez, M.C. (2007)  
Spanish Journal of Agricultural Research 5(3): 333-340

##### Summary

The grapevine cultivar 'Albariño' is one of the oldest grown in the vine-growing areas of north-western Spain and northern Portugal. Since recognition of Origin Denomination status for the Rías Baixas region (the coast of western Galicia, Spain) in 1987, the economic importance of this cultivar has increased, and its grapes are now among the most expensive in Spain. The area occupied by 'Albariño' vines in this region is increasing every year, and the wines made from its grapes are gaining international

recognition. These events, plus the fact that 'Albariño' was little known outside its traditional growing area, have led to speculation about its origin and the existence of synonyms. Misnames of 'Albariño' have included 'Savagnin Blanc' and 'Caíño Blanco'. The present work compares 'Albariño', 'Savagnin Blanc' and 'Caíño Blanco' ampelographically (i.e., it compares shoot, leaf, grape cluster, berry and seed characteristics) and molecularly using microsatellite markers. The results show that they are in fact three different cultivars providing a complete description. For 'Caíño Blanco', there is little previously reported information.

### **Influence of Rootstock Type on the Agronomic Characteristics of Two Grape (*Vitis Vinifera* L.) Cultivars Grown in the Northwestern Iberian Peninsula.**

Santiago, J.L.; Gago, P.; Boso, S; Alonso-villaverde, V.; Martínez, M.C. (2007)  
Plant Production Science 10(4): 473-477

#### Summary

In this work, we compared in three consecutive years (2001, 2002, 2003), the effects of rootstock 110-Richter and SO4 over some determined production parameters in two of the main important grape cultivars (Albariño and Caíño Tinto) regarding to economy in the North-West of Spain and also cultivated in the North of Portugal. The results showed that the type of rootstock used can influence some of the production variables of these cultivars. The behaviour of both rootstocks was different according to the cultivar. As long as for Albariño the rootstock did not influence in the parameters of production, in Caíño Tinto, it was proved that there were significant differences ( $p < 0.05$ ) for some of these parameters (cluster weight and weight of the pruning wood per plant) according to the rootstock. As we expected, some significant differences were observed within these parameters on the basis of climatologic conditions of any year.

### **Influence of rootstock on resistance of *Vitis cv. Albariño* clones to downy mildew**

Boso, S.; Santiago, J.L.; Martínez, M.C. (2007).  
European Journal of Horticultural Science 72(4): 179-185

#### Summary

Resistance of leaves and fruit clusters of *Vitis vinifera* 'Albariño' clones to downy mildew (*Plasmopara viticola*) using non-grafted plants and plants grafted on 110-R. All the experimental plants had been growing since 1993 at the Misión Biológica de Galicia, Spain. Both in terms of their leaves and clusters, some clones were more resistant to infection than others. Some were more susceptible to primary attack than secondary attack, while others showed the opposite characteristics. The degree of susceptibility to disease was independent of the rootstock used or indeed of whether the plant had been grafted or not.

### **The grapevine cultivar Mencia (*Vitis vinifera* L.): similarities and differences with respect to other well know international cultivars.**

Martínez, M.C.; Santiago J.L ; PÉrez, J.E.; Boso, S. (2006)  
Journal International des Sciences de la Vigne et du Vin 40(3): 121-132

#### Summary

The red wine grapevine cultivar Mencía is grown over much of northern and northwestern Spain. It is the preferential cultivar for the wines of the Appellation C ntrol e regions of "Bierzo", "Monterrei", "Ribeira Sacra" and "Valdeorras", and an 'authorized' cultivar for "R as Baixas" and "Ribeiro" wines. This cultivar does not seem to have existed in the north of Spain until the end of the 19th century (after the arrival of phylloxera), but from this time on it has been one of the most important of all those cultivated. The interest surrounding its true identity has increased over the years as its market value has increased. Some parties defend it as a native of the area while others believe it to be a synonym of Cabernet Franc or Tintilla. It is also similar to cv. Garnacha, as some authors have mentioned over the years (although with no great emphasis) (Garc a de los Salmones, 1901-1911; Comenge, 1942; Galet, 1990). The present paper reports a comparative ampelographic study of different clones of Menc a and Garnacha. The results are also compared to those published by other authors. Menc a appears to be totally different to Cabernet Franc and Tintilla but shows characteristics similar to those of Garnacha and there is possibly a parental relationship. Menc a might therefore be obtained from different crosses between Garnacha and another cultivars.

#### **High variable *Vitis* Microsatellite loci for the identification of grapevine Pinot noir clones.**

Regner, F.; Hack, R.; Santiago, J.L. (2006)  
*Vitis* 45(2): 85-91

##### Summary

Nineteen new microsatellite loci of *Vitis* were elaborated by following the procedure of tagging an SSR-enriched library. Primers for these VRG markers were used for genotyping grapevines. Only the markers VRG 1, VRG 2, VRG 4, VRG 7, VRG 9, VRG 10, VRG 15 and VRG 16 show heterozygous alleles and Mendelian segregation. Other VRG loci such as VRG 5, VRG 6, VRG 11, VRG 12, VRG 13 and VRG 17 produce a multi-allelic profile and some of them show distorted segregation. Variability of the VRG loci is rather high as compared to other grapevine SSR markers. Stable VRG markers such as VRG 16 can be useful for the identification of cultivars. Highly variable VRG microsatellites could be successfully applied to trace polymorphism within the variety Pinot Noir. Clones of Pinot Noir could be differentiated using these markers. By applying the PhyQuest program, a dendrogram showing the genetic divergence within Pinot Noir clones was constructed.

#### **Ampelographic comparison of grape cultivars (*Vitis vinifera* L.) grown in northwestern Spain and northern Portugal.**

Santiago, J.L.; Boso, S.; Mart nez, M.C.; O. Pinto-Carnide, O.; Ortiz, J. M. (2005)  
*American Journal of Enology and Viticulture* 56(3): 287-290

##### Summary

The vinegrowing regions of northwestern Spain and northern Portugal are geographically adjacent. In order to prove the hypothesis of existing synonymies, ampelographic comparisons were carried out with 7 Spanish cultivars and 13 Portuguese cultivars. Mature leaves were selected and ampelographic characteristics proposed by the OIV for the description of the vine cultivars were measured. The basic

parameters for the reconstruction of the mean leaf were recorded. Five synonymies were confirmed after analyzing the data of the different cultivars. A doubtful synonymy was detected in two other cultivars. The remaining cultivars were clearly distinguished.

**A method to evaluate downy mildew resistance in grapevine.**

Boso, S.; Santiago, J.L.; Martínez, M.C. (2005)  
Agronomy for sustainable development 25: 163-165.

Summary

Downy mildew, caused by *Plasmopora viticola*, is one of the endemic cryptogamic diseases of northern Spain that most commonly affects grapevines. In order to quantify the different levels of resistance in the field against this disease it is necessary to evaluate Downy mildew resistance without interfering in the development of the plant. The authors describe an original method performed with an analysis imaging software. This method allows one to clearly and objectively identify and quantify clones or varieties with greater resistance to cryptogamic diseases. The reliability of this method is demonstrated.

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**Ampelographic and agronomic variability of two Iberian grapevine cultivars grafted onto 110R and SO4 rootstocks**

Boso, S.; Gago, P.; Alonso-Villaverde, V.; Santiago, J.L.; Martínez, M.C. (2010).  
International Journal of Fruit Science 10:195-214.

Summary

This work compares the effects of two different rootstocks (110R and SO4) on a number of ampelographic and production variables in two grape cultivars ('Albariño' and 'Caíño Tinto') of great importance in north-western Spain and in northern Portugal.

Plants growing under the same conditions were studied over a period of three years. The effect of the two rootstocks differed depending on the cultivar. No influence of rootstock was seen on production in 'Albariño', but significant differences were seen in terms of cluster weight and weight of pruning wood in 'Caíño Tinto'. The rootstock type did not influence the ampelographic characteristics of either cultivar.

**Wine-growing and artistic heritage union for the appreciation of the old world's viticulture**

Gago, P.; Santiago, J.L.; Boso, S.; Alonso-villaverde, V.; Martínez, M.C. (2009).  
Bulletin de L'OIV 82: 495-506.

Summary

The north and northwest of the Iberian Peninsula is home to a number of ancient grapevine cultivars now in danger of extinction, regarding which the literature contains but a few references dating from the 19th century. In this region, baroque religious art, which is commonly ornamented with grapevines motifs, reached great importance. This work reports the ampelographic description of leaves and clusters from 19 ancient cultivars, and also the comparison of the leaves and clusters of old grapevine varieties from this region with those represented on baroque altarpieces. Many of the latter were found to be ampelographically correct representations of grapevine leaves and clusters.

**Synonymy of two ancient grapevine varieties (*Vitis vinifera* L.) - Cascón and Corbillón - from the D.O. Rías Baixas Ribeira do Ulla subzone (Galicia, Spain)**

Gago, P.; Santiago, J.L.; Boso, S.; Alonso-villaverde, V.; Martínez, M.C. (2009)  
International Journal of Fruit Science 9(2): 157-165

Summary

In 1986, the Spanish CSIC began a project to find, describe, and recover ancient grapevine cultivars in the regions of Galicia and Asturias. Almost 100 such cultivars have been found, all of which now form part of the grapevine collection at the Misión Biológica de Galicia (CSIC). Until now, the red cultivars "Cascón" and "Corbillón," two of the most ancient cultivars of the Ribeira do Ulla subzone Protected Designation of Origin (P. D. O.) Rías Baixas, remained undescribed. An ampelographic and molecular analysis of these cultivars showed them to in fact be one and the same.

### **Quantitative Trait Loci Analysis of Erinose (*Eriophyes vitis* Pgst.) on a Genetic Map Welschriesling x Sirius.**

Santiago, J.L., Mandl, K.; Hack, R., Regner, F. (2009)  
Acta Horticulturae 827: 341-346

#### Summary

Three biological races of Erinose (*Eriophyes vitis* Pgst. sin *Colomerus vitis* Pgst.) commonly attack vineyards every year. A genetic map Welschriesling x Sirius (Mandl et al. 2006) was used as the basis of QTL (quantitative trait loci) analysis for Erinose. The symptoms were evaluated in five consecutive years in 92 individuals from this segregating population and other OIV traits related to the density of hairs in different tissues were also scored. QTL analysis was performed on all data using Plabqtl version 1.1. A major QTL for Erinose sensitivity was identified and reproducible every year on linkage group 9d close to the SSR marker VMC5c1. Two additional smaller QTLs could also be identified in linkage groups 5 and 17. The fact that some OIV traits related to the density of hairs were linked to the same group of the genetic map, is also discussed.

### **The variability within the cultivar Grüner Veltliner under different aspects.**

Regner, F.; Hack, R.; Hanak, K.; Santiago, J.L. (2009)  
Acta Horticulturae 827: 245-252

#### Summary

'Gruener Veltliner' is the main cultivar in Austrian viticulture. About 30% of the national production is derived from this grapevine. Recently, in some wine districts, 'Gruener Veltliner' has been used for producing monovarietal wines with controlled origin (Districtus Austriae Controllatus, DAC). In order to reach a typical sensorial profile of the wine, linked to the cultivar from which the wine is derived, two of the most decisive steps are to improve the homogeneity of the material and to use the recommend clones. Therefore, we analysed clones and types of 'Gruener Veltliner' according to their sensorial behaviour, their differences in aroma compounds, and their genetic profiles. Sensorial description was done by a panel test. The desired prototype is a spicy and peppery wine with stone-fruit aroma. The aromatic compounds that differentiated the clones were mostly found in acids, phenolics, and sulphur related compounds. The genetic differences of the clones were investigated using 270 SSR markers. Based on these data, the relationship between the types was calculated and their differences were demonstrated.

### **Relation between the susceptibility to botrytis and the morphology of the cluster in the grapevine cultivar Albariño (*Vitis vinifera* L.)**

Alonso-Villaverde, V.; Boso, S; Santiago, J.L.; Gago, P.; Martínez, M.C. (2008)  
International Journal of Fruit Science 8(4): 251-265

#### Summary

The grapevine (*Vitis vinifera* L.) cultivar Albariño is well adapted to damp climatic conditions in northwestern Spain and is of great economic importance in the area. The damp, mild conditions of this region are, however, also optimum for the development of

fungi such as *Botrytis cinerea* that attack grapevines. Different ‘Albariño’ clones were found to vary in susceptibility to infection. Morphological differences in the clusters, berries, and rachises of these clones were then sought and their relationship with this susceptibility examined. One of the 14 clones studied—with the shortest pedicels and the smallest berries—was clearly more resistant to this fungus.

### **Ampelographic and agronomic characteristics in different clones of Albariño cultivar (*Vitis vinifera* L.)**

Boso, S.; Santiago J.L.; Vilanova, M.; Martínez, M.C. (2005)  
Bulletin de L'OIV 78: 143-158

#### Summary

The “Albariño” is one of the most important and interesting cultivars in Galicia (northwest of Spain), however, until the present there were not selected clones of this cultivar. In 1987, in “Consejo Superior de Investigaciones Científicas” prospection of centenary “Albariño” specimens was initiated, in different geographic points in Galicia. Forty centenary “Albariño” specimens were located (source plants) and 11 of them were selected. In 1993, 10 repetitions of each one of the 11 selected plants were grafted, in the collection of the Misión Biológica de Galicia (CSIC). Based on the differences observed among the different source plants, each one of these 11 selected plants, was considered a different clone of “Albariño”. Ampelographic and agronomic variability was studied on the selected 11 clones of “Albariño” cultivar (*Vitis vinifera* L.). Different ampelographic parameters were measured and observed in green shoot, mature leaf, cluster, berry and seed, on the selected clones according to the OIV's method (1983). The reconstruction of the average leaf was carried out in each one of the clones, according to the Martínez and Grenan's method (1999). Different agronomic parameters were studied: weight of clusters per vine, weight and size of clusters, berries and seeds, number of grapes per cluster, number of seeds in each grape, must yield, probable alcoholic degree, acidity in must etc. There was no significant difference between clones for any of the studied ampelographic parameters, except for two clones (CSIC-1 and CSIC-2) which presented the base of the petiole sinus limited by the nerve. Each one of the 11 clones presented different agronomic characteristics. Some of them varied with a lower weight of clusters per vine, with clusters and berries of small size, and others showed a higher probable alcoholic degree, and high acidity. Finally some of them presented higher size clusters, a high probable alcoholic degree, and a typical level of acidity in Albariño cultivar.

## Artículos de Divulgación

### **Descripción de tres variedades de vid (*Vitis vinifera* L.) en la zona de Betanzos (A Coruña).**

Gago, S.; Boso, J.L.; Santiago, V.; Alonso-Villaverde, I.; Orriols, J.E.; Pérez, M.C.; Martínez, M.C. (2010)

Boletín Informativo, Sociedad Española de Ciencias Hortícolas 23(1): 6-7

### **Description de la zone viticole de montagne des Asturias (Nord de l'Espagne).**

Martínez M.C.; Boso, S.; Alonso-villaverde, V.; Gago, P.; Santiago, J.L. (2009)

Viticultura de Montagne 17: 66-75

### **Evaluación de la incidencia a enfermedades fúngicas en diferentes clones del cv. Albariño (*Vitis vinifera* L.).**

Boso, S.; Rodríguez, E.; Santiago, J.L.; Alonso-Villaverde, V.; Gago, P.; Martínez, M.C. (2009)

Phytoma 210: 30-34

### **Tinta Castañal (*Vitis vinifera* L.), variedad de interés en la subzona Rosal (D.O. Rías Baixas)**

Santiago, J.L.; Boso, S.; Gago, P.; Alonso-Villaverde, V.; Martínez, M.C. (2009)

Boletín Informativo, Sociedad Española de Ciencias Hortícolas 22(1): 4-5.

### **Susceptibilidad a *Plasmopara viticola* (Berk. and Curt) Berl. and de Toni, en diferentes variedades de vid (*Vitis vinifera* L.)**

Boso, S.; Santiago, J.L.; Gago, P.; Alonso-Villaverde, V.; Martínez, M.C.; Kassemeyer, H-H. (2008)

Boletín de Sanidad Vegetal 34: 387-397

### **Desarrollo intercelular de *Plasmopara viticola* en genotipos de vid susceptibles y resistentes.**

Boso, S.; Santiago, J.L.; Alonso-Villaverde, V.; Gago, P.; Martínez, M.C. (2007)

Revista de Agricultura y Agropecuaria 902: 888-890

### **Viticultura de montaña en Asturias. Primeros clones certificados de dos de sus variedades autóctonas.**

Martínez, M.C.; Boso, S.; Gago, P.; Alonso-Villaverde, V.; Santiago, J.L. (2007)

La semana vitivinícola 3197: 3846-3847

### **La colección de variedades de vid de la Misión Biológica de Galicia (CSIC). Interés científico e industrial.**

Martínez, M.C.; Boso, S.; Santiago, J.L. (2006)



Agricultura. Revista agropecuaria 886: 510-512

**Variabilidad intravarietal en el nivel de resistencia a Mildiu (*Plasmopara viticola*) en la variedad Albariño (*Vitis vinifera* L.).**

Boso, S.; Santiago, J.L. y Martínez, M.C. (2005)

Revista de Viticultura y Enología profesional 100: 7-20