Govern de les Illes Balears
Conselleria d'Agricultura, Medi Ambient i Territori

# GRAPEVINE LEAFROLL-ASSOCIATED VIRUS 3 (GLRaV-3) EFFECTS ON THE PHYSIOLOGY IN VITIS VINIFERA L. (CV. ESCURSAH)

**R. Montero*, J. Bota**

Institut de Recerca i Formació Agrària i Pesquera (IRFAP), Conselleria d'Agricultura, Medi Ambient i Territori. Govern de les Illes Balears. C/Eusebio Estada nº 145. 07009, Palma de Mallorca, Spain
*Corresp. author: R. Montero, Tel. : +34 971176100, Fax : +34 971177107, Email: rmontero@dgagric.caib.es

## ABSTRACT

The study was performed during summer of 2011. Experiment was carried out in a twelve year old vineyard in Majorca ( Balearic islands, Spain ). Three Vitis vinifera L. (cv. Escursah) plants infected with GLRaV-3 and three virus free plants of this variety were measured. Stomatal conductance (g s ), transpiration (E), leaf net photosynthesis (A), leaf surface exposed and leaf specific weight were measured in field-grown plants in three different moments throughout the summer season. The yield (grape production (kg)/plant) was measured at harvest in 3 plants per treatment. Quality parameters of the grape were measured in must, like sugar content (baumé), total acidity and pH. The results showed no significant differences in all parameters measured. Even that, leaf net photosynthesis in infected plants was 5% lower than in virus free plants. Also reductions in yield were observed (27%). The virus infection did not affect the grapevine vigor. Finally the quality parameters were very similar in all the plants. No differences between treatments could be attributed to low virulence of the viral strains or probably the host tolerance. Future experiments including virus quantitation (qRT-PCR) would be interesting for complete this study.

## MATERIAL AND METHODS

**Plant material and virus diagnosis**
Twelve-year-old-grapevines (Vitis vinifera L.cv. Escrusach on R-110 rootstocks) grown side by side in a experimental vineyard of Majorcan government, Spain (UTM: Huso 31; X : 471355; Y : 4382481), were investigated during the 2011 summer season. The planting density was 2222 vines ha-1. Three plants infected with GLRaV-3 and three plants virus free were used for the experiment. The presence of this virus was tested using commercial enzyme-linked immunosorbent assay (ELISA) coating and conjugate antibodies preparations (Bioreba AG, Reinach, Switzerland).

**Gas Exchange measurements**
Leaf net photosynthesis (A), stomatal conductance (gs) and transpiration rate (E) were measured in six leaves per cultivar in four different times: flowering (M0), ripening (M1) and harvest (M2). Measurements were done between eight and ten hours (solar time) using an IRGA open system Li-6400 (Li-Cor Inc., USA). All measurements were done at saturated light (1500 µmol m-2 s-1) and at CO2 concentration of 400 mmol CO2 mol-1 air.

**Growth measurements**
Leaf surface exposed was measured throughout the summer. It was determined measuring length and width for each leaf, and calculating the total surface.

**Leaf Plant production and grape quality**
Yield (grape production (kg)/plant ), and number of clusters, were measured at harvest in 3 plants per treatment. Three samples of 100 berries were randomly taken from the total grape production of the three plants in each treatment. The grape weight was measured and sugar content (baumé), total acidity and pH were measured in must.

## RESULTS AND DISCUSSION

**Differences in leaf surface exposed**

We did not find differences in growth. Only in one infected plant the surface was clearly lower than in the other cases. But the plant growth is very similar. There is not a similar trend in each treatment during the summer time.

This was a preliminary study to identify the main limitations of the virus on the plant physiology. We want to know when these limitations affect to the correct behavior of the plant.

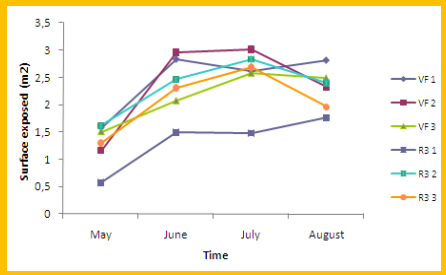


***Figure 1.*** Evolution of leaf surface exposed to the time *in virus free plants (VF) and GLRaV-3 (R3).*

.

**Changes in photosynthesis**

Several findings demostrate that there are a lot of negative effects, because of leafroll virus infections. These effects are associated with grapevine physiological disturbances, mainly with photosynthesis, respiration, transport and accumulation of assimilates, mineral nutrition and hormonal balance processes, which in turn have direct consequences on all aspects of growth and cropping (Mannini et al., 1996; Sampol et al., 2003).

We did not find significant differences in photosynthesis. Throughout the summer the values in the virus free plants were a little bit higher than in infected plants. At the end of the summer the photosynthesis in virus free plants and infected plants, were lower than at the beginning. It was because the irrigation was lower in this period.

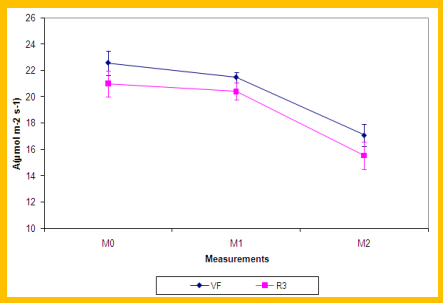


***Figure 2.*** *Relationship of photosynthesis (A) to the time in virus free plants (VF) and GLRaV-3 (R3).* flowering (M0), ripening (M1) and harvest (M2)

**Differences in yield and grape quality**

Depending on the strain, grapevine cultivar and environmental conditions, leafroll virus infections can negatively influence the yield, sugar content and acidity of the must, berry skin phenolic content, resistance to biotic and abiotic stress and length of growing cycle and the vigour (Guidoni at al., 1997 ; Cabaleiro et al. 1999).

There were not significant differences in photosynthesis, but the yield was significantly lower in infected plants. Although the 100 berries weight was higher in infected plants than in virus free plants. The quality parameters were very similar in all the plants.

Would be interesting to study the assimilation transport to identify possible limitations.

***Table 1.*** *Averages of yield, number of bunches, weight of bunches and quality parameters*

| Treatment | VF | R3 |
|---|---|---|
| Prod Unit (g) | 4630±338,08 | 2623,33±355,03 |
| Nº bunches | 18,33±2,40 | 15,33±2,03 |
| Bunches weight (g) | 256,19±14,40 | 172,25±13,60 |
| 100 berries weight (g) | 197,40±8,60 | 255,14±6,97 |
| Sugars (ºBaumé) | 10,33±0,44 | 10,52±0,13 |
| Sugars (g/l) | 186±8,01 | 189,4±2,43 |
| pH | 3,77±0,03 | 3,80±0,03 |
| Total acidity (g tartaric acid/l) | 5,06±0,19 | 4,69±0,21 |

## CONCLUSION

The Grapevine Leafroll-associated Virus 3 (GLRaV-3), did not affect the grapevine vigor throughout the summer. Leaf net photosynthesis in infected plants was 5% lower than in virus free plants. But reductions in yield were observed (27%). There were not differences in quality parameters. No differences between treatments could be attributed to low virulence of the viral strains or probably the host tolerance. Future experiments including virus quantitation (qRT-PCR) would be interesting for complete this study.

## LITERATURE

**Cabaleiro C., Segura A., Garcia-Berrios J. (1999)** Effects of grapevine leafroll associated virus 3 on the physiology and must of Vitis vinifera L. Cv. Albarino following contamination in the field. American Journal of Enology and Viticulture, 50, 40–44.

**Guidoni S., Mannini F., Ferrandino A., Argamante N., Di Stefano R. (1997)** The effect of grapevine leafroll and rugose wood sanitation on agronomic performance and berry and leaf phenolic content of a Nebbiolo clone (Vitis vinifera L.). American Journal of Enology and Viticulture, 48, 438–442.

**Moutinho-Pereira J., Correia C.M., Gonçalves B., Bacelar E.A., Coutinho J.F., Ferreira H.F., Lousada J.L., Cortez M.I. (2012).** Impacts of leafroll-associated viruses (GLRaV-1 and -3) on the physiology of the Portuquese grapevine cultivar "Touringa Nacional" growing under field conditions. Annals of Applied Biology 3-4746.

**Mannini F., Argamante N., Credi R. (1996)** Improvements in the quality of grapevine Nebbiolo clones obtained by sanitation. Acta Horticulturae, 427, 319–324.

**Sampol, B., Bota, J., Riera, D. Medrano, H., & Flexas, J., (2003).** Analysis of the virus-induced inhibition of photosynthesis in malmsey grapevines. New Phytologist, 160 (2), 403-412