

Virus Diseases: Summary of the answers from interviewed scientists

Piero A. Bianco (Dipartimento di Scienze Agrarie e Ambientali –
Università degli Studi di Milano. Italy

The diseases caused by viruses in grapevine are increasing their importance in all of the world but the knowledge concerning their effects on the production are almost unknown and then underestimated.

Nevertheless in many Countries the winemakers have the chance to **use certified material, such as grapevine sapling virus free belonging to a selected clones.**

The major effort is then the conservation of the clone collections and their protection from the possible infection due to soilborne pathogens but, much more frequently, from that pathogens that are transmitted in field by airborne vector such as insect or mites.

In addition to the “old” diseases, recently new threats are emerging in Europe and USA: the occurrence of severe epidemics caused by new viruses are respectively due to **Grapevine Pinot Gris virus (GPGV)** and **Grapevine Red Blotch virus (GRBV)**. The study concerning their aetiology and epidemiology are still in progress.

The scientists who received the questionnaire

Surname Name	Country	Affiliation	e-mail address	TOWN
Al Rwahnih Maher	USA	University of California-Davis	malrwahnih@ucdavis.edu	
BUCIUMEANU Elena-Cocuta	România	Institutul Național de Cercetare-Dezvoltare pentru Biotehnologii în Horticultură Ștefănești-Argeș	ebuciumeanu@yahoo.com	Ștefănești-Argeș
BURGER Johan	South Africa	Stellenbosch University	jtb@sun.ac.za	Stellenbosch
CABALEIRO Cristina	Spain	Universidad de Santiago de Compostela, Escola polytecnică superioară	Cristina.Cabaleiro@usc.es	Lugo
FIORE Nicola	Chile	Univ de Chile, Dep Produccion Agricola	nfiore@uchile.cl	Santiago
FUCHS Marc	USA	Department of Plant Pathology, Cornell University	mf13@cornell.edu	Cornell NY
GOLINO Deborah	USA	Department of Plant Pathology, Davis University of California	dagolino@ucdavis.edu	Davis CA
HABILI Nuredin	Australia	Waite Diagnostics, University of Adelaide UMR Santé de la Vigne et Qualité du Vin, INRA & Université de Strasbourg	nuredin.habili@adelaide.edu.au	Glen Osmond SA
HERRBACH Etienne	France		etienne.herrbach@colmar.inra.fr	Colmar
IPACH Ulrike	Germany	Dienstleistungszentrum ländlicher Raum	ulrike.ipach@dlr.rlp.de	Neustadt
IZADPANA Keramatollah	Iran	College of Agriculture, Shiraz University	izadpana@shirazu.ac.ir	Shiraz
JOHNSON Raymond	Canada	Canadian Inspection Food Agency	Ray.Johnson@inspection.gc.ca	Sidney BC,
KOLBER Maria	Hungary	Fitolab – Plant pest diagnostic and Advisory	kolber.maria@fitolab.hu	Budapest
LEMAIRE Olivier	France	UMR Santé de la Vigne et Qualité du Vin, INRA & Université de Strasbourg	olivier.lemaire@colmar.inra.fr	Colmar
MAWASSI Munir	Israel	The Volcani Center	mawassi@volcani.agri.gov.il	Bet Dagan
PIETERSEN Gerhard	South Africa	Department of Microbiology and Plant Pathology, University of Pretoria	gerhard.pietersen@up.ac.za	Pretoria
RAYAPATI Naidu	USA	Washington State University	naidu@wsu.edu	Prosser
ROWHANI Adib	USA	Department of Plant Pathology, Davis University of California	akrowhani@ucdavis.edu	Davis CA
SABANADZOVIC Sead	USA	Department of Entomology and Plant Pathology, Mississippi State University	ssabanadzovic@entomology.msstate.edu	MS 39762, MS
SALDARELLI Pasquale	Italy	Istituto di virologia vegetale, CNR	p.saldarelli@ba.ivv.cnr.it	Bari
SKORIC Dijana	Croatia	Department of Biology, University of Zagreb	dijana@botanic.hr	Zagreb
WETZEL Thierry	Germany	RLP – AgroScience GmbH - Alplanta	thierry.wetzel@agrosience.rlp.de	Neustadt
ZAHAVI Tirtza	Israel	Extension service, Ministry of Agriculture	tirtzaz@yahoo.com	Ramat Hagolan

1. Quelle est la situation des maladies de type viral de la vigne dans votre pays?

Which is the situation of virus diseases in your Country ?

The answers are almost homogeneous and are quite similar for the European Countries where the soilborne diseases (infectious degeneration complex including fanleaf etc.) are very important in France, in particular for the prestigious cultivar and areas (Champagne, Bourgogne...etc).

In Germany the prevalence is just for fanleaf disease, with Grapevine Fan Leaf Virus (GFLV), Arabis Mosaic Virus (ArMV), and Raspberry ringspot virus (RpRSV) (Cherry strain) found in the vineyards of Palatinate and other areas.

Very low is the presence and the effect of GFLV in Spain where the most important disease is Leafroll, that is spreading quite rapidly probably due also to the presence of efficient vectors. In France also has been observed a LR spread in Northern part of the Country.

Different panorama is occurring in Italy where clonal selection activity conducted in several regions supplied new and better clones of local and international varieties. Even if it does not exist an official source of information concerning frequency and distribution of virus diseases of grapevine, on the basis of the preliminary (and mainly related to northern Italy) results, the leafroll associated viruses Grapevine leafroll-associated virus 1 and Grapevine leafroll-associated virus 3 (GLRaV-1 and GLRaV-3) are prevalent even if GFLV and ArMV are increasing, in particular in the commercial vineyards.

At the question 4 an extended information will be given concerning the detection and identification of Grapevine Pinot Gris virus in Italy.

2. Quel est l'objectif principal de votre programme de recherche en termes de virose de la vigne?

Which is the main objective in your research program on grapevine virus diseases?

Plant viruses are intracellular pathogens and their eradication is almost impossible to reach as possible and reliable result. Then the first strategy for the disease containment is based on the virus exclusion from planting material. Therefore development of new diagnostic tools are the common objective of many research groups in Europe and in other Countries (USA, Australia and Chile). The second issue is related to the containment of the virus spread in vineyard since most of the most relevant grapevine viral diseases are propagated by vectors such insects and mites. The recent tendency for the low impact management on plant protection implies the development of new tools for the vector population control, possibly based on pesticide free, or lower input, strategies.

Here below are summarized the main topics and the related Countries.

The Next Generation Sequencing (NGS) (Italy, France and USA) and Microarray technology (USA) as innovative and powerful detection methods are developed mainly for the detection of viruses associated with diseases at unknown aetiology. Interesting results have been obtained for the detection and identification of GPGV in Italy and other new viruses such as GSyV-1 in France and USA.

Also relevant studies in Europe are addressed towards the studies of the cell and molecular interaction in the system plant (grapevine)-virus and vector: in particular for fanleaf and leafroll diseases (France, Germany and Italy). Studies on virus resistance and set up of suitable strategies for the virus control by means of biotechnology tool such as RNA interference and transgenic plants (France).

Virus elimination by tissue culture are developed in Australia, Romania and USA (macro shoot tip and meristem culture).

Greater efforts are applied in several Countries for the improvement of the control strategies to contain spread of airborne diseases caused by *Ampeloviruses* (GLRaV-1 and GLRaV -3) and *Vitivirus* (GVA). In France due to the relevant importance of nepoviruses studies of integrated management of nematode vector/s are carried out by mean of chemical treatments and agronomic measures.

In Israel specific programs are carried out in order to evaluate the effects of agronomic practices on performance of virus infected vines. Also, field trials for control of the mealybug (*Planococcus ficus*) using chemicals, male disruption and/or biological control with [*Cryptolaemus montrouzieri*](#) are carried out.

Concerning the studies on new viruses and undefined disease aetiology researches are in progress for the GPGV, GSyV-1 and other *Marafiviruses*, Grapevine ruspestris stem pitting virus, Grapevine Rupestris vein feathering virus in Italy. Also, in Italy has been recently reported the presence and the diffusion of a new virus GPGV found in Trentino (North eastern Italy) subsequently recorded from other Italian regions (Emilia-Romagna, Veneto, Friuli-Venezia Giulia and Lombardy) as well as from South Korea, Slovenia, Slovakia, Czech Republic and Greece. Several studies are in progress in order to evaluate the role of this virus and/or its strains in the symptom expression (mottling and deformation of the leaves).

Studies on the GLRaV transmission, epidemiology (by monitoring mealybug leafroll) and symptomatology are carried out in Spain. Also, damage evaluation of leafroll on yield and production and the effect of rootstocks on the diseased vines are conducted.

3. Avez- vous estimé le dommage économique que la virose provoque sur la production totale de vin dans votre pays?

Did you have a crop losses data and the economic impact of the virus diseases on enological production?

The best data obtained from this question comes from Marc Fuchs that reports the values of **economic impact of leafroll disease the United States: from \$25,000 to \$40,000 per hectare in New York, \$81,000 to \$202,000 per hectare in Napa Valley in California, \$41,000 to \$102,000 per hectare in Sonoma in California and \$26,900 to \$67,900 per hectare in San Joaquin Valley in California over a 25 year vineyard lifespan.**

Other data are narrower and related to particular varieties such those of Mannini and colleagues in Italy for Nebbiolo cultivar (Mannini et al., 2012) and Pinot gris for GPGV (Malossini et al., 2012). No recent data are available from France and according to Marc Fuchs data, **previous estimates of the economic impact of Grapevine fanleaf virus indicated \$1.0 billion annual losses in France.**

In Spain and Israel specific large scale evaluation are in progress and the data will be published in the next months (Caballeiro et al., in press).

In general reliable and significant data are not available or they are too old (i.e. Germany). This is probably due to the fact that no better incoming are expected from a better quality berry yield.

4. Avez- vous identifié de nouvelle virose pour la vigne dans votre pays ?

Did you have recently identified new virus diseases in your Country?

The answer of the question number 4 is representative of the real state of the art concerning the major emergent problems for the healthy grapevine propagating material.

In particular in France Tomato black ring virus (TBRV, Nepovirus) has been found in the Bordelais area (Laveau et al., 2013) and Grapevine Syrah virus 1 (GSyV-1, Marafivirus) (Beuve et al., 2013).

In Germany Grapevine Pinot Gris Virus and Grapevine rupestris stem pitting virus (by NGS, to be confirmed) have been identified.

In USA (New York, California and Washigton) Red blotch, a newly recognized, virus disease in North America has been found by the groups in Geneva (Cornell University) and in Davis (UC - California). The economic impact of GRB disease is very high and its causal agent (GRBV a DNA virus) has been fully sequenced. No information are so far available concerning the epidemiology even if critical has been found the role of the propagating material.

In Italy as mentioned above a new virus disease was discovered in the Trentino Region. Unusual symptoms of chlorotic mottling, leaf deformation and stunting were observed since 2003 on the cultivar Pinot gris and Traminer. The disease affects yield and qualities of the productions. A virus was discovered on these plants which was named Grapevine Pinot gris virus (Giampetruzzi et al., 2012). The virus was also reported in several other Italian Region (Friuli Venezia Giulia, Veneto, Emilia Romagna, Puglia and Lombardia) (Martelli, 2014, Casati et al., 2014), Korea (Cho et al. 2013), on the table grape Tamnara inducing a necrosis of the berries; Slovak and Czech Republics (Glasa et al., 2014) on different cultivars; Slovenja (Plesko et al., 2014), on the cvs Pinot gris, Sauvignonasse and Muscat blanc, associated with a similar symptomatology. Studies are in progress with the aim to clarify the role of GPGV on the disease aetiology, to understand the virus biology and epidemiology and to develop fast diagnostic tools.

No other available information are coming so far from other Countries. It is reasonable to expect a great increase of the virus findings in the next years in the view of the a larger use of this new technique (NGS).

5. Est-ce qu'il y a une urgence phytosanitaire liée aux viroses dans votre pays?

Are there emergent phytosanitary problems for grapevine in your Country?

The major concerns according to the scientist answers are quite different. Leafroll spread is an emergent problem for France, Germany, Israel and USA and northern Italy. This is probably due to the reduced (and conceivable) use of insecticides and the consequent increase of the insect vector populations. For France, USA and some areas of Italy the major concern is the persistent presence of fanleaf and its probably spreading in particular where and when preventing measures are not applied.

For Italy, as above reported, the new grapevine disease associated with Grapevine Pinot gris virus is clearly an emergent phytosanitary problem in several premium viticultural areas in the Northern of Italy. Similar symptoms were described on several wine varieties, cvs Traminer and Pinot noir in Trentino, Friuli Venezia Giulia cv Glera, in Veneto, Chardonnay, in Lombardy and recently in the table grapes Black magic and Supernova in Apulia.

In Chile there are not yet phytosanitary emergencies, but there are problems with GFLV (and vector management: *X. index*), GLRaV-1, -2, -3, and with Syrah Decline. Information from scientists from Spain and South Africa gives a prominent concerns to phytoplasma disease, respectively for Flavescence dorée and Aster Yellows (AY)

6. Quelles sont selon vous les publications scientifiques de références de ces deux dernières années en matière de virose de la vigne?

Could you list the most significant publications, in our opinion, on grapevine virus diseases in the last two years?

The papers suggested as important are 33.

7. Quelles sont selon vous les choses à faire? Quels sont les obstacles pour bien comprendre en profondeur les maladies de type viral ?

Which are the main constraints for the improvement of the knowledge of virus diseases?

The most frequent answer given by the scientists to the second part of the question might be summarized with the following sentence: shortage of funding and insufficient network between scientists from different Countries that are facing the similar problems.

Another interesting answer attributes a great importance to the lack of consciousness (and correct information) about the economic impact of viral diseases such as fanleaf and leafroll and then suggests to set up novel and more efficient strategies for their control in particular for fanleaf.

Some of the answers deserve to be reported integrally, as supplied by the scientists.

Pasquale Saldarelli and G.P. Martelli (Italy): ... Differently from what we observe in other continents (i.e. several Countries in the Americas, Australia), Europe gave up research in grapevine virology, which is mainly linked to the emergence of new diseases (see the GPGV case) and/or regionally funded. In parallel, new viruses, also belonging to new taxa with a DNA genome (see GRBV) were described in the USA, whose presence in Europe is completely unknown. In addition, important questions in basic grapevine virology, mainly related to the etiology of single viruses alone and in synergy, did not meet any reception in recent EU funding programs. Because of this, the European scenario is made by an always more limited number of grapevine virologists which, occasionally and independently, continue to work in this field.

Marc Fuchs (USA): Limited financial resources and limited interest of the industry leadership in Europe are major constraints to research on viruses and viral diseases.

8. Comment faites- vous pour informer les producteurs/vignerons des résultats de votre travail scientifique?

COUNTRY	ACTIVITIES
AUSTRALIA	Articles on growers' magazines: Australian Viticulture or Aust. New Zealand <u>grapegrower</u> and winemaker. University linked website: http://www.agwine.adelaide.edu.au/facilities/wdiag/
CHILE	Through seminars, field days, extension articles. Providing technical advisory services and analyzing plant material.
FRANCE:	Seminars, brochures, trade shows, open days (open doors), meetings, articles in the professional press.
GERMANY:	<u>Advisory</u> service, meetings Open doors day at institute, publications in journals for professionals
ISRAEL	Growers meeting – regional, national and at wineries at which we lecture about the work. Annual and final reports of the researches are published in <u>web-sites</u> of the wine board and the local research organizations (all in Hebrew). The final results are also published as articles in our local grower's journal " <u>Alon Hanotea</u> ". Field days to teach about symptomatology, vectors and the ways to control them.
ITALY	Presentation and <u>reports</u> to General Assembly of the " <u>Associazione Costitutori Viticoli Italiani</u> ". Regional and district meeting for winemakers and growers. Meetings with extension service (i.e. Phytosanitary service) personnel.
ROMANIA	Television and newspapers reportages inform the farmers.
SPAIN	Meetings, roundtables, and field <u>visits</u> with vine growers/winemakers organized by territorial agricultural institutions and extension services
SOUTH AFRICA	Contacts with Wine –industry based organization, <u>Vinpro</u> , who do the technology transfer tasks, or co-ordinate them with relevant researchers.
USA	Regular contact with growers, vineyard managers, <u>vintners</u> and <u>industry</u> leaders through <u>onsite visits</u> , participation at grower's conventions and <u>personal extension responsibilities</u> .

9. Est-ce que vous seriez intéressé à participer à une future collaboration multinationale de recherche et quels sont pour vous les aspects à rechercher?

Would you be interested to collaborate at possible future international research project and could you suggest the main issues that should be investigated?

Total support to the idea of a common project of grapevine virus diseases has been supplied by the interviewed scientists. The major topics for the possible program of investigation are here below listed:

applying and evaluating techniques of next generation sequencing for the diagnosis of grapevine virus and virus-like diseases

evaluating the aetiological role of widely diffused viruses and their strain diversity.

studying the molecular interactions among Grapevine fanleaf virus and/or Grapevine leafroll associated viruses and the grapevine

studying the aetiological role and the molecular evolution of the recently discovered and emergent viruses such as Grapevine Pinot gris virus and Grapevine Syrah Virus -1

Studies of genomic and metagenomic of viral diseases.+

Investigation of the phenomenon of tolerance or resistance against viral infection

Development of quick and cheap diagnostic tools.

Evaluation of economic impact of the main grapevine virus diseases also considering the diversity of involved virus strains and grapevine growing regions

Rien est plus incroyable d'une réponse a une quésition que n'était pas posée