Vitis **25**, 227—275 (1986)

SCIENTIA VITIS ET VINI

The viroses and virus-like diseases of the grapevine

A bibliographic report, 1979—1984

by

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Foreword

The compilation of 'bibliographic reports' on virus and virus-like diseases of *Vitis* species was initiated in 1965, under the auspices of the International Council for the Study of Viruses and Virus Diseases of the Grapevine (ICVG).

Three reports have already been published:

CAUDWELL, A.; 1965: Bibliographie des viroses de la vigne des origines à 1965. Office International de la Vigne et du Vin, Paris, 76 pp. (references 1—1019).

CAUDWELL, A.; HEWITT, W. B.; BOVEY, R.; 1972: Les viroses de la vigne. Bibliographie de 1965—1970. Vitis **11**, 303—324 (references 1020—1386).

HEWITT, W. B.; BOVEY, R.; 1979: The viroses and virus-like diseases of the grapevine. A bibliographic report 1971—1978. Vitis **18**, 316—376 (references 1387—2163).

The present report constitues the fourth of the series, covering the period from 1979 through 1984. It includes 20 references (2164—2183) of papers published prior to 1979, which had been omitted in previous lists and all papers presented at the 8th Meeting of ICVG held in September 1984 in Bari, Italy, whose Proceedings were published in the first 1985 issue of Phytopathologia Mediterranea.

636 references of research papers or reviews on virus, mycoplasma-like organisms and virus-like diseases of *Vitis* spp., their causal agents, vectors, control measures and various aspects of practical applications of virological knowledge to the improvement of viticulture are contained in this presentation. As in previous bibliographic reports, reference on Pierce's and Kerner diseases — a well established and a possible bacterial disorder, respectively — are also included since contributed papers on these diseases were presented at the ICVG Meetings of Niagara Falls (1980) and Bari (1984).

A 'Subject Index' made up of about 200 entries completes the bibliographic lists to expedite consultation and facilitate search for wanted information.

The sources of references were:

1. Data from computerized retrieval services such as: (i) Agricola Database and Biosis Previews, obtained through Dialog Information Services, Palo Alto, California, USA; (ii) Commonwealth Agricultural Bureaux (CAB), U. K., and Biopascal, France, obtained through the European Space Agency Information Retrieval Service (ESA-IRS), Frascati, Italy.

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2. Lists of publications kindly provided by several colleagues, to whom the warmest thanks are expressed.
3. Direct consultation of journals and periodicals available at the library of the Federal Agricultural Research Station of Changins, Nyon, Switzerland or borrowed from other libraries.

Most of the references obtained from computerized retrieval services and from lists sent by colleagues were checked in the original.

Preparation of bibliographic reports is one of the activities promoted by ICVG, whose main goal is fostering international research on the nature, epidemiology and control of virus and virus-like diseases of grapevines.

ICVG is a free association of scientists with a membership of over 150 virologists and viticulturists from about 30 different countries who meet periodically (usually every three years) to discuss the results of current research and their applications.

Information concerning ICVG and the meetings may be obtained from the Secretary or any member of the Steering Committee. They are:

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The 9th Meeting of ICVG will be held in September 1987 in Israel. The organizer is Dr. E. TANNE (Volcani Agricultural Research Center, P. O. Box 6, Bet Dagan, Israel) who may be contacted for information.

Comments

That the interest of scientists for virus and virus-like diseases of *Vitis* has not subsided since the last bibliographic report, is demonstrated by the abundant literature (more than 600 papers most of which are research notes) produced in the last six years. All major fields of grapevine virology have been explored but emphasis was placed on the study of unresolved problems (e. g. the etiological definition of diseases like leafroll and the stem pitting-corky bark complex) which were long debated in ICVG Meetings.

A detailed analysis of the outcome of the investigations carried out throughout the world in the last few years is far beyond the scope of this presentation. Therefore, only some of the significant discoveries and advances will be mentioned and briefly commented.

New records (viruses, virus and virus-like diseases)

1. Diseases

Grapevine yellow dwarf (2316) is a disease reported from Taiwan, characterized by chlorosis, mottling and yellow blotching of the leaves in spring, followed by malformation and stunting of the plants. Affected vines contain enveloped, roughly spherical virus-like particles ca. 80 nm in diameter, which resemble particles of tomato spotted wilt virus. This confirms the susceptibility of grapevines to viral pathogens that prevail in the areas of its cultivation.

A severe dieback and decline of vines of cv. Kerner was observed in Germany and described under the name of 'Kerner disease'. Among other symptoms, it induces deep grooves and pits in the xylem (2281, 2398, 2663, 2664). The disease kills the vines and has brought to a stop the use of the valuable cv. Kerner in German grape-growing districts. The pathogen is likely to be a xylem-limited bacterium which, so far, has resisted cultivation in artificial media (2399).

Vein yellowing leafroll is another new disease reported from the Champagne region of France (2309, 2310). The symptoms are like those of leafroll but the pattern of spread in the field resembles that of 'bois noir'. Similarly to 'bois noir', MLOs are suspected to be the causal agents of vein yellowing leafroll.

Outbreaks of diseases likely to be induced by MLOs and resembling flavescence dorée, have been repeatedly reported from the Americas (2303, 2594) and Europe, with special reference to Italy (2242, 2243, 2336, 2416, 2418) where they are causing concern to the growers.

Fleck (2186, 2210, 2479, 2526, 2642, 2679, 2729, 2794), vein necrosis (2177, 2256, 2339, 2679) and vein mosaic (2187, 2339, 2554, 2596) are more and more often recorded from different countries when indexing on proper indicators is carried out. Vein mosaic, a graft-transmissible disease latent in many varieties, was compared with Australian summer mottle and found to be different despite the symptomatological similarities (2791).

Graft-transmissible pathogens latent in cv. Plant droit, Riesling of Japanese origin and Savagnin but inducing chlorosis, stunting and reddening of the leaves in cv. Pinot noir, were reported from France (2500, 2779). Always in France, intriguing cases of graft incompatibility were observed between cv. Colombard, Abouriou and Pinot noir and the rootstock Kober 5BB (2357, 2378, 2779). This incompatible condition is associated with an unidentified, graft-transmissible, heat labile agent. Graft incompatibilities are becoming more and more obvious with the increased use of clonal rootstocks and scions thus indicating the existence of additional, elusive and potentially pathogenic conditions in propagative material.

2. Viruses

Novel isolations of aphid-transmitted viruses have been reported. These refer to cucumber mosaic virus in Denmark (2178), an absolute new record, broad bean wilt virus in South Africa (2301) and alfalfa mosaic virus in Czechoslovakia (2610, 2762), Hungary (2234, 2235) and Germany (2290). It appears then, that infection by some of these viruses (notably alfalfa mosaic virus which induces a distinct yellow mosaic-like syndrome) should no longer be regarded as a mere scientific curiosity. Whether they will become a real economic threat remains, however, to be seen.

Nematode-transmitted viruses have remained one of the major objects of research. Among them, grapevine fanleaf virus maintains a pre-eminent position for some 90 or so papers were devoted to various aspects of its pathogenicity, epidemiology, detection

and control. Among other findings, the most remarkable ones refer to its possible occurrence in weeds in California (2465), to the presence of a natural serological variant, the first found so far, in Tunisia (2682) and to the study of its strategy of replication in rabbit reticulocyte lysate (2565).

Other nepoviruses have not been overlooked. Thus, for instance, comparative studies for a better physico-chemical and serological characterization were carried out with tomato black ring and grapevine chrome mosaic viruses (2510), grapevine Bulgarian latent, CM-112, and blueberry leaf mottle viruses (2391, 2636, 2637), tomato ringspot virus strains from California and New York State (2602). Moreover, detailed accounts were given on symptoms, pathogenicity and diagnosis of raspberry ringspot virus infections to grapevine in Germany (2283, 2289, 2666, 2667) and new records of arabis mosaic and grapevine fanleaf viruses in Japan (2476), tomato black ring virus in Israel (2716) and Canada (2714) were provided as a consequence of introduction of infected propagating material from abroad.

Closteroviruses are undoubtedly the issue of the moment. Several different possible such viruses were found associated with major but etiologically undefined diseases like leafroll and the stem pitting-corky bark complex. Unfortunately, except for grapevine virus A (GVA), a closterovirus with particles 800 nm long that is mechanically transmissible (with difficulty) and was thoroughly characterized (2252, 2329), all other closteroviruses are, as yet, very little known. Most of the available information stems from electron microscope observations of crude extracts or thin sectioned tissues of diseased vines. The 'Subject index' lists some 20 papers under the entry 'closterovirus(es)'.

Two such viruses, which are serologically distinct from one another and from GVA and have particles measuring 1800 and 2200 nm, respectively, were reported from Switzerland as being preferentially associated with leafroll (2427, 2428). However, a comparable association with leafroll was reported for GVA in South Africa (2366, 2367) and Israel (2721).

It is evident, as pointed out in 2333, that at the present status of knowledge, no difinitive conclusions can be drawn on the role of closteroviruses in the etiology of any of the diseases with which they are associated.

Vines with (2298, 2299, 2300) or without (2223) apparent symptoms of leafroll may contain also non mechanically transmissbile virus-like isometric particles ca. 30 nm in diameter, which are restricted to the phloem and induce vesiculated inclusion bodies derived from deranged mitochondria.

In Japan, the simultaneous presence of the agents of leafroll and fleck in vines of the cv. Koshu, causing the so-called ajinashika disease, seems to produce more severe symptoms than those of leafroll alone (2730).

3. Viroids

Although in the present report only one paper on viroids in grapevine is quoted (2695), subsequent work published in 1985, has shown that two or more viroidal RNAs occur in grapevine of different origins. How much these viroids are widespread, and whether they are pathogenic and induce symptoms will likely be the subject of investigations in the years to come.

Detection and diagnosis

Grafting on woody indicators (indexing) still constitues the major if not the only procedure for identifying disease agents that are not transmissible to herbaceous hosts.

Trials for leafroll detection (2286, 2358, 2360, 2362), have confirmed that cv. Mission is less sensitive and reliable than several other cultivars like Cabernet franc, Cabernet Sauvignon, Pinot noir and Merlot.

Indexing procedures were also developed for alfalfa mosaic (2505) and grapevine chrome mosaic (2504) viruses.

Improved serological methods like ELISA (enzyme-linked immunosorbent assay), IEM (immune electron microscopy) and ISEM (immunosorbent electron microscopy) have become extremely popular in the last few years, greatly contributing to expedite search for viruses, their identification and seasonal distribution in vine organs. More than 30 references are listed under the entry 'ELISA' in the 'Subject index', referring to detection of several nepo- and clostero-viruses in grapevine tissues and nematode vectors (2266), as well as the Pierce's disease bacterium in plant tissues (2585).

ISEM, on the other hand, proved useful for the identification of viruses in vines and nematode vectors and of the agent of flavescence dorée in liquid media and extracts of plant and insect vectors (see references under specific entry in 'Subject index').

It can be foreseen that more sophisticated and very sensitive methods like, for example, nucleic acid hybridization with radioactive probes, will be applied in the near future for detecting viroids and non mechanically transmissible viruses.

Epidemiology and vectors

Although this subject was by no means neglected, not many significant advances have been made, with a few noteworthy exceptions.

Longidorus diadecturus was recognized as a new vector of peach rosette mosaic virus in Canada (2203). Other nematodes possibly implicated in the transmission of nepoviruses to grapevines were *Xiphinema rivesii* (2384, 2385) and the recurrent *X. vuittenezi* (2659), which has long been suspected but never proven beyond doubt as a true virus vector.

Impressive natural spread of corky bark was reported from Mexico (2723, 2725) but the vector, thought to be an air-borne insect, was not identified. Conversely, a new leafhopper vector of Pierce's disease was discovered in California (2582), the causal agent was localized inside the vector (2272) and the mechanisms of transmission were elucidated (2623).

Perhaps the most striking finding consists in the experimental evidence that GVA can be acquired from infected grapevines and transmitted to herbaceous hosts by three mealybug species: *Pseudococcus longispinus, Planococcus citri* and *Planococcus ficus* (2651, 2652). Similar results were obtained in South Africa together with evidence that leafroll, with which GVA is associated, spreads naturally in the field (2367).

The recognition that mealybugs are capable of transmitting also in nature one or more closteroviruses, may represent a major epidemiological breakthrough in grapevine virology, whose significance will be properly evaluated in the years to come.

Control

Chemical control of vectors for impairing the spread of infections by viruses or xylem- and phloem-limited prokaryotes, has scored some success with the latter group of pathogens (2566, 2567, 2616). Soil fumigation against nematode vectors was not always equally effective (see references under entry on 'Chemical control' in 'Subject

index'). Data from California indicate that after heavy applications of fumigants, no recurrence of *Xiphinema index* is observed for 4—5 years. Then a gradual build-up of nematodes and affected vines is registered, reaching an incidence of 3—5 % after 10 years' growth (2498, 2639).

The use of resistant or tolerant varieties and/or rootstocks may therefore represent the answer to this problem (2268, 2414, 2639). Sources of resistance to GVF were identified in some *Vitis vinifera* varieties, resistance to the transmission of GVF by *X. index* was found in *Muscadinia* (= *Vitis) rotundifolia* (2267, 2269) and resistance to *X. index* in hybrids of *V. rufotomentosa* (2436).

Production and distribution of virus-free material still represents the main issue of any sanitation programme. Considerable improvements in the efficiency of virus elimination were obtained with the use of *in vitro* culture of various types of grapevine explants, alone or in combination with heat therapy or chemotherapy. The list of 80 or so references under entries 'heat therapy' and '*in vitro* culture' in the 'Subject index' gives an idea of how widely these techniques are being applied throughout the world.

Subject Index

Acknowledgements

We wish to thank Prof. W. B. HEWITT for kindly reading the manuscript and suggesting corrections, and Mrs N. MIAUTON, of the Federal Agricultural Research Station of Changins, for typing the manuscript.

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Eingegangen am 13. 8. 1986

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