

Grapevine summer mottle: a new graft-transmissible disease

by

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Grapevine summer mottle — eine neue pfpföbertragbare Krankheit

Zusammenfassung. — Bei routinemäßigen Blattkontrollen im Rebensortiment von Merbein wurde eine bislang noch nicht beschriebene Krankheit entdeckt, für welche die Bezeichnung „grape summer mottle“ (GSM) vorgeschlagen wird. Die Symptome, die bis jetzt nur bei einer einzigen Herkunft der Sorte Sideritis (*Vitis vinifera*) gefunden wurden, äußern sich während des Sommers als ein systemisches Scheckungssyndrom. Durch Pfpföbertragung wurden bei den *V. vinifera*-Sorten Cabernet Franc, Mataro, Mission, Mission Seedling 1 und der Hybride Baco 22 A ähnliche Symptome hervorgerufen, nicht jedoch bei den Indikatorreben *V. rupestris* St. George und LN 33. Die Krankheit konnte mit dem Saft nicht auf eine Reihe krautiger Pflanzen übertragen werden, und die durchgeführten serologischen Tests verliefen ebenfalls negativ. Die Ergebnisse weisen darauf hin, daß die Symptome durch einen unbekanntem pfpföbertragbaren Erreger verursacht werden.

Introduction

Our routine inspections revealed a virus-like disease in all vines of *Vitis vinifera* L. cv. Sideritis (syn. Chimoniatiko) growing in a variety collection at CSIRO Division of Horticultural Research, Merbein. This table grape cultivar is grown commercially in Greece but not in Australia.

This paper describes foliar symptoms and transmission tests of a disease not previously described for which the name grapevine summer mottle (GSM) is proposed.

Materials and methods

Graft-transmission tests

Plants of *Vitis vinifera* L. cvs. Cabernet Franc, Mataro (syn. Esparte), Mission, Mission Seedling 1 (a selected seedling of Mission), and of hybrids LN 33 and Baco 22 A were inoculated with dormant buds of suspect Sideritis using the chip-bud technique (HEWITT *et al.* 1962). These young indicators were inoculated in spring, and three replicates of each indicator together with corresponding uninoculated controls were transferred to the field (TAYLOR and WOODHAM 1972). Foliar observations were recorded regularly during three or more growing seasons.

Vitis rupestris SCHEELLE cv. St. George plants were inoculated with the Sideritis by dormant chip-bud and green-graft techniques. Five plants were treated by each method and maintained for inspection under glasshouse and shadehouse conditions for three years. The viability of all inoculum chips was checked 10 or 12 weeks after grafting.

Sap-inoculation tests

All inocula were prepared from fresh expanding laminae sampled either from *Sideritis* cuttings forced in a glasshouse or from field source vines in spring and summer. All plants sampled in spring were symptomless whereas about 30 % of the leaves in the summer sample showed GSM symptoms. Crude macerates and concentrated extracts were prepared in both sampling periods.

The crude extracts were prepared by grinding 1 g of laminae to 4 ml of 2.5 % nicotine solution (CADMAN *et al.* 1960). Concentrated extracts were obtained from 10 g of laminae homogenised in 40 ml of 0.06 M Na-K phosphate buffer pH 8 (containing 2.5 % nicotine plus 8.5 % w/v polyvinylpyrrolidone or 0.02 M cysteine-HCl) and concentrated by one cycle of differential centrifugation (R_{av} 2,300 g for 5 min; 74,000 g for 150 min). The high-speed pellet was resuspended in minimum volume of 0.03 M phosphate buffer pH 8.

These inocula were applied with the finger to carborundum-dusted leaves of young plants of: *Chenopodium quinoa* WILLD., *C. amaranticolor* COSTE and REYN., *Gomphrena globosa* L., *Cucumis sativus* L. cv. Windermoor Wonder, *Cucurbita maxima* L. cv. Butternut, *Phaseolus vulgaris* L. cv. Contender, *Nicotiana tabacum* L. cv. White Burley, *N. glutinosa* L., *Petunia hybrida* VILM. cv. Balcony, and *Vigna sinensis* (L.) ENDL. cv. Black Eye. In some tests, these herbs were exposed to a 24 h dark period before inoculation. Leaves were rinsed with distilled water immediately after inoculation. These plants were maintained in a glasshouse (18–26 °C; 200–250 $\mu\text{E m}^{-2} \cdot \text{s}^{-1}$ photosynthetically active radiation) or in a controlled growth cabinet (20 °C; 12 h day length; 130–150 $\mu\text{E m}^{-2} \cdot \text{s}^{-1}$) and inspected regularly during periods of four to eight weeks depending on host species. The absence of infection was confirmed by back-inoculation to corresponding herbs.

Serological tests

Concentrated extracts of laminae sampled in spring and summer from *Sideritis*, from Cabernet Franc inoculated with *Sideritis*, and from healthy Cabernet Franc were tested by the OUCHTERLONY gel double-diffusion procedure (BALL 1974) against the following antisera (reciprocal of homologous titres in parentheses): grapevine fanleaf (1024), arabis mosaic (512), tobacco ringspot (256), tobacco mosaic (unknown), tobacco necrosis (2048), tomato ringspot (256), tomato black-ring (256), tomato bushy stunt (2048), strawberry latent ringspot (64–128), and the grape isolate of peach rosette mosaic (1024). Tests were made at antisera dilutions ranging from 1 : 2 to 1 : 16 in petri dishes containing 0.75 % Ionagar, 0.15 M NaCl, 0.015 M NaN_3 , with 5 mm diameter wells spaced 5 mm apart and arranged radially around a central well.

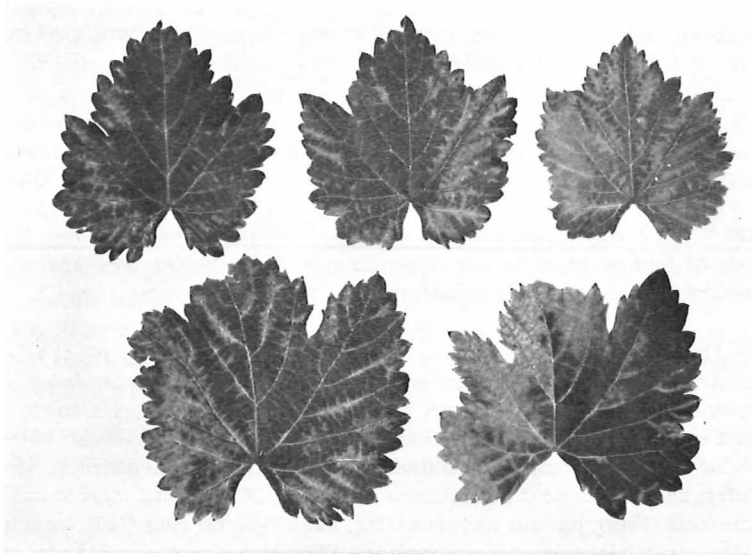
Results

Typical GSM leaf symptoms are illustrated in the figure. Initial symptoms on individual leaves range from mild yellowish feathering of sections of main veins or veinlets to yellowish mottling commonly uniform and delineated by main veins but sometimes affecting virtually the entire laminae. Broken areas of mottle may be confined to interveinal areas or form pseudo line-patterns. Later, small red-coloured areas occur on severely affected parts of leaves of *Sideritis* and of infected black-fruited cultivars. Symptoms on field vines usually develop in early summer on young expanding and recently matured leaves and remain systemic on actively

growing shoots through to autumn. Many leaves per vine can be affected. No cane abnormalities are associated with infected vines. Young *Sideritis* vines grown in a glasshouse or shadehouse develop typical symptoms during their first summer.

Similar leaf symptoms were induced on all bud-inoculated Cabernet Franc, Mataro, Mission, Mission Seedling 1, and Baco 22 A in the second and third growing seasons after grafting. However, successfully budded St. George and LN 33 did not show GSM-associated symptoms. Graft-transmission tests revealed that our *Sideritis* clone is simultaneously infected with three other known diseases namely leafroll, yellow speckle (TAYLOR and WOODHAM 1972), and fleck.

The numerous attempts during several years to mechanically transmit GSM to a range of herbaceous plants were unsuccessful. The immuno-diffusion tests performed with concentrated extracts from *Sideritis* and infected Cabernet Franc failed to show any reactions which could be associated with GSM.



A range of summer mottle disease symptoms in *Vitis vinifera* cv. *Sideritis*.
 Verschiedene Grade der Symptomausprägung des grapevine summer mottle bei *Vitis vinifera* cv. *Sideritis*.

Discussion

Results demonstrate that GSM leaf symptoms are associated with a graft-transmissible disease. Symptomatology, host range, and serological evidence distinguish GSM from any previously reported disease of grapevine.

GSM leaf symptoms may be confused with those reported for grapevine vein mosaic (POP 1973), for a summer mosaic disease reported in several *V. vinifera* cultivars (VUITTENEZ 1966), for Hungarian chrome mosaic (MARTELLI *et al.* 1970), and for grapevine yellow mosaic (DIAS 1970). However, although vein mosaic and the summer mosaic disease are not mechanically transmitted to herbs, both produce

disease symptoms in St. George, whereas GSM does not. Also Hungarian chrome mosaic and yellow mosaic differ from GSM in being easily sap-transmitted to herbs.

GSM cannot be explained by synergy between leafroll, fleck and yellow speckle diseases because this combination is commonly encountered during routine virus indexing on the same vine indicators as used in this experiment and does not induce the GSM symptoms. Our Sideritis vines came from a variety collection at Rutherglen, Victoria, but the prior overseas source and history are unknown. It seems likely that GSM disease was introduced into Australia with Sideritis vines rather than being transferred from existing vines in Australia.

In the absence of any uninfected Sideritis vines we have no data to indicate the effect of GSM *per se* on vine performance. However, the infected Sideritis vines grow well, and seem no different or inferior to those described by LOGOTHETIS (1972). Also the inoculated indicator vines do not show growth abnormalities. We have no evidence of natural spread to other vines growing adjacent to Sideritis for 13 years in the field or between infected and healthy indicator vines planted 1 m apart during a four-year indexing period.

Summary

Foliar inspections of the Merbein grapevine cultivar collection have revealed a previously unreported disease for which the name grapevine summer mottle is proposed. The symptoms, which to date have been found only in a single provenance of the cultivar Sideritis, are expressed during summer as a systemic mottling syndrome. Similar symptoms were reproduced in graft-inoculated Cabernet Franc, Mataro, Mission, Mission Seedling 1, and Baco 22 A but not in St. George or LN 33 indicator vines. The disease was not sap-transmissible to a range of herbaceous plants and did not react with several antisera. Results indicate that the symptoms are caused by an unknown graft-transmissible agent.

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Literature cited

- BALL, E. M., 1974: Serological tests for the identification of plant viruses. Amer Phytopathol. Soc., St. Paul, Minnesota.
- CADMAN, C. H., DIAS, H. F. and HARRISON, B. D., 1960: Sap-transmissible viruses associated with diseases of grape vines in Europe and North America. *Nature* **187**, 577-579.
- DIAS, H. F., 1970: Grapevine yellow mosaic. In FRAZIER, N. W. (Ed.): Virus diseases of small fruits and grapevines, 228-230. Univ. Calif., Berkeley.
- HEWITT, W. B., GOHEEN, A. C., RASKI, D. J. and GOODING, G. V. JR., 1962: Studies on virus diseases of the grapevine in California. *Vitis* **3**, 57-83.
- LOGOTHETIS, B., 1972: Sideritis. O.I.V. *Rég ampél. intern.* No. 361.
- MARTELLI, G. P., LEHOCZKY, J. and QUACQUARELLI, A., 1970: Hungarian chrome mosaic. In: FRAZIER, N. W. (Ed.): Virus diseases of small fruits and grapevines, 236-237. Univ. Calif., Berkeley.

POP, I. V., 1973: Grapevine vein mosaic. *Riv. Patol. Veg.*, Ser. 4, 9, 243—250.

TAYLOR, R. H. and WOODHAM, R. C., 1972: Grapevine yellow speckle — a newly recognised graft-transmissible disease of *Vitis*. *Austral. J. Agricult. Res.*, 23, 447—452.

VUITTENEZ, A., 1966: Observations sur une mosaïque de la vigne, probablement indépendante du virus du court-noué. *Ann. Epiphyt.*, 17, no. hors-série: Etudes de Virologie, 67—73.

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