

Virus diseases of orchids in The Netherlands

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Abstract

The most commonly encountered virus diseases in orchid plants in The Netherlands are caused by *Cymbidium* mosaic virus (CyMV) and *Odontoglossum* ringspot virus (ORSV), either singly or in combination. Data on host ranges are given.

Introduction

During the period from September 1959 until June 1960, I spent a sabbatical leave at the University of Utrecht, under the Fulbright Program, at the invitation of Professor Dr L. C. P. Kerling and as a guest in the laboratory at Baarn. The staff and the facilities of the Phytopathologisch Laboratorium "Willie Commelin Scholten" made possible an investigation of some of the orchid virus diseases occurring in The Netherlands.

The Canton Garden orchid collection proved to be of great value as a source of orchid species, and the commercial orchid growers in the Netherlands were generous in supplying diseased plants for experimental use.

Viruses, or virus-like symptoms, have been reported from a large number of orchid genera (Jensen, 1959). The virus diseases most commonly encountered in orchid plants in The Netherlands, as in America, were caused by two viruses either singly or in combination. These are *Cymbidium* mosaic virus (CyMV) and *Odontoglossum* ringspot virus (ORSV), the latter being related to tobacco mosaic virus. Both viruses are highly infectious, stable, and are usually present in orchid juice in high concentrations. Also both viruses have rather wide host ranges among orchid genera and species. Electron microscopy was used from time to time to confirm the identity of the respective viruses.

The present paper will discuss some data on the two important orchid virus diseases and will give a survey of my own results in studying the host ranges of CyMV and ORSV and in identifying various orchids isolated in The Netherlands.

Some data from the literature

Cymbidium mosaic

This is probably the most commonly found virus disease of orchids throughout the world. Its symptoms were described in Australia by Magee (1943), who inferred a viral etiology. Jensen (1950, 1951) experimentally transmitted the virus from *Cymbidium* to *Cymbidium*; Gold and Jensen (1951) reported electron microscopy of the causal virus

particles which are sinuous rods (about $18 \text{ nm} \times 475 \text{ nm}$), and Jensen and Gold (1955) determined that CyMV is also the cause of a common leaf necrosis disease prevalent in orchids of the genus *Cattleya* and its hybrids. It also occurs in a number of other orchid genera and can infect certain non-orchid host plants.

Odontoglossum ringspot.

This disease was described from *Odontoglossum grande* by Jensen and Gold (1951), who also reported on the size of the rod-shaped virus particles ($24 \text{ nm} \times 280 \text{ nm}$) as determined in the electron microscope. Subsequently, ORSV was shown to occur in *Cymbidium* (Jensen and Gold, 1952), where it was called *Cymbidium* diamond mottle, and in *Cattleya* (Jensen, 1959), where it causes some flower variegation.

Relationships between ORSV and TMV were evident but unclear for several years. What was obviously the same virus, based on electron microscopy, was reported from orchids by Newton and Rosberg (1952), Perez et al (1956), and Murakishi (1958b). The form and size of ORSV and TMV are so similar that they cannot always be consistently distinguished in the electron microscope (Brandes and Chessin, 1965). However, in host range and some other respects they show differences.

The most thorough investigations of the relationships of ORSV to TMV were made by Paul et al. (1965). The ORSV isolate used in their studies was one supplied by the present writer from among the *Cymbidium* plants found infected in The Netherlands (Brandes, 1964).

The conclusions reached by Paul et al. (1965) are that ORSV and TMV are distantly related serologically and are not identical. In the analytical ultracentrifuge, purified ORSV showed two peaks whereas TMV gave only one peak under identical conditions. They concluded that ORSV is related to TMV *vulgare* and that the degree of relationship is similar to that of TMV *vulgare* and Holmes' ribgrass isolate.

Inouye (1966) and Corbett (1967), on the basis of host range and serology, and Corbett (1967), from electron microscopy, also concluded that TMV and ORSV, though related, are significantly different.

Host ranges of Cymbidium mosaic and Odontoglossum ringspot viruses.

Both of these common viruses infect a wide range of orchid genera and species. Also, there is now an increasing list of non-orchid host plants which are susceptible to infection by one or both of these viruses. The viruses to which certain of these plants are susceptible, however, have not been unequivocally determined. It is probable that in some cases both viruses, instead of only one, were present in the inoculum or that the single virus used was misidentified.

Datura stramonium was shown by White and Goodchild (1955) to develop local lesions when inoculated with CyMV. It is apparently not susceptible to ORSV. An even better indicator for the presence of CyMV (and the absence of ORSV) is *Cassia occidentalis*, which develops local lesions in 4–6 days (Corbett, 1960), as do also *C. tora* and *C. bacapsularis*. Also reported as hosts of CyMV are *Tropeolum majus* L., *Oryza sativa* L., *Passiflora edulis* Sims and *Zinnia elegans* Jacq. (Murakishi, 1958a).

Gomphrena globosa is an excellent selective indicator host plant for ORSV which causes local lesions on the inoculated leaves in approximately 10 days but does not react to CyMV. Thus, a mixture of CyMV and ORSV can be separated and identified by inoculation to *Cassia* and *Gomphrena*.

In an extensive and valuable host range study, Hollings (1959) tested 52 viruses on 15 different non-orchid plant genera. One of the viruses was listed as *Cymbidium* mosaic virus derived from *Cymbidium*. However, the inoculum used in the host range experiment came from *Gomphrena* or *Primula*. Thirteen of the fifteen genera and species inoculated were recorded as positive.

We now know that *Gomphrena globosa* is not a host of CyMV, but is susceptible to ORSV. It is probable, therefore, that Hollings' inoculum from *Gomphrena* was actually ORSV rather than CyMV. Other plants reported by Hollings as being susceptible to the orchid virus or viruses in his inoculum were: *Chenopodium amaranticolor* Coste & Reyn., *Beta vulgaris* L., *Amaranthus caudatus* L., *Celosia argentea* L., *Tetragonia expansa* Murr., *Phytolacca americana* L., *Portulaca oleracea* L., *Fagopyrum esculentum* Moench., *Primula malacoides* Franch., *Lythrum salicaria* L., and *Stellaria media* Vill. The latter five were listed as symptomless. Only *Primula* and *Stellaria* were systemically invaded.

Host range studies

The writer's orchid investigations in The Netherlands included host range studies of orchid viruses involving some of the above test plant species used by Hollings. On the basis of a large number of inoculations from many orchid virus sources, the following conclusions were drawn. *Cymbidium* mosaic virus produced local lesions on *Datura stramonium* and *Cassia occidentalis* but caused no symptoms in *Tetragonia*, *Gomphrena*, *Chenopodium amaranticolor*, *Nicotiana tabacum* 'Xanthi', *N. tabacum* 'Samsun', or *Zinnia elegans*.

Odontoglossum ringspot virus caused local lesions on *Gomphrena*, *Chenopodium*, *Nicotiana tabacum* 'Xanthi' and *Tetragonia*, but caused no symptoms on *Cassia*, *Datura*, or *Amaranthus*.

Amaranthus plants were inoculated with CyMV from four sources, with ORSV from six sources and with a mixture of both viruses from four sources. In no case were there decisive symptoms of infection.

Chenopodium developed local lesions after inoculation from eight sources of ORSV only, and from four sources carrying both ORSV and CyMV, but in none of seven experiments in which the inoculum was CyMV only.

Among the additionally known hosts of ORSV are *Zinnia elegans* (Jensen and Gold, 1952), in which the only symptoms was a transitory variegation of the flowers, *Chenopodium quinoa* (Brandes, 1964), *C. capitatum* and *C. ficifolium* van Regenmortel et al., 1964).

Nicotiana tabacum 'Samsun' was found by Paul et al. (1965) to develop no symptoms of ORSV infection, but the virus reached a high concentration in the inoculated leaves after a build up of 3 weeks. They also found that *N. tabacum* 'Xanthi' was a good local lesion host in which ORSV did not become systemic. Although *Nicotiana glutinosa* is a good local lesion host for TMV, most efforts to use it as an indicator for ORSV have been unsuccessful. However, Paul et al. (1965) found that although ORSV produced no symptoms in this plant in the summer, inoculated leaves did develop grey flecks of variable size in the spring and fall.

Identification of Dutch isolates

In addition to *Cymbidium*, *Cattleya* and *Cattleya* hybrids, orchid viruses were recover-

ed from other orchid genera in The Netherlands. *Calanthe*, with chlorotic spots on the leaves, yielded inoculum that produced CyMV symptoms in *Cymbidium*, *Cassia* and *Datura*. Lesions were also produced in *Chenopodium* but not in *Gomphrena*. *Laelia rubescens*, with mosaic leaf symptoms, carried CyMV but not ORSV. *Vanda sumatrana*, with black lesions on the leaves, yielded juice that produced virus symptoms in *Spa-thoglottis* orchid but failed to infect *Cymbidium* or the indicator hosts for either CyMV or ORSV.

Miltonia regnelli Rchb.f. had mosaic leaf symptoms which may have been due to CyMV present in very low concentration, as suggested by a very few lesions on the inoculated cotyledons of *Cassia*.

Ada aurantiaca, with numerous brown to rose-colored spots on the under surface of the leaves, and *Schomburgkia crispa* Lindl., with mosaic leaves, were found to be infected with CyMV.

A *Phalaenopsis* plant, with white sunken areas on the older leaves, was carrying both CyMV and ORSV.

Variegated flowers were found, but only rarely, on *Cymbidium* plants in The Netherlands. They resembled somewhat the color breaking of *Cymbidium* flowers in Japan illustrated by Inouye (1965). The identity of the virus in The Netherlands is still obscure because when juice from the flowers was inoculated to *Nicotiana tabacum* 'Xanthi', *Cassia*, *Gomphrena*, *Tetragonia* and *Phytolacca americana*, symptoms occurred only on *N. xanthi*, where numerous lesions developed on the inoculated leaves.

Samenvatting

Virusziekten van orchideeën in Nederland

De meest algemeen voorkomende virusziekten van orchideeën in Nederland worden veroorzaakt door *Cymbidium*-mozaïekvirus (CyMV) of *Odontoglossum*-kringvlekken-virus (ORSV) of door een combinatie van beide virussen. Aan de waardplantenreeks van beide virussen wordt uitvoerig aandacht geschonken.

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