

Orchids: the mechanical transmission of Viruses by water, tools, and tables and perspective to control

Background and objectives

Recirculating irrigation systems are developed to increase production and to increase a more efficient use of water, energy, nutrient, and pesticides and at the same time to decrease emissions to the environment and to reduce the rapid spread of soil borne pathogens. Close systems enable an improved plant growth by a better control and make it possible for the grower to adapt to the market demands and to produce quality products. But the methods by which irrigation water is applied in greenhouses can influence both, the spread of plant pathogens within a crop, and the disease development.

Within our investigations on ebb-flow irrigation which recycles water and implicates the potential exists for spread of pathogens, we focus on orchid cultures and investigate the possible **transmission of important orchid viruses in orchid cultures** by nutrient solution of ebb-flow irrigation.

Growers fear virus infections in their cultures because they may cause severe yield losses. Plants may show badly developed or less flowers or unexpected colouring. The need of disinfecting tables and tools to reduce virus transmission is discussed.

Materials and methods

We selected German orchids farms of major importance in orchid production who apply recycled irrigation water. Hundreds of orchids were tested to find

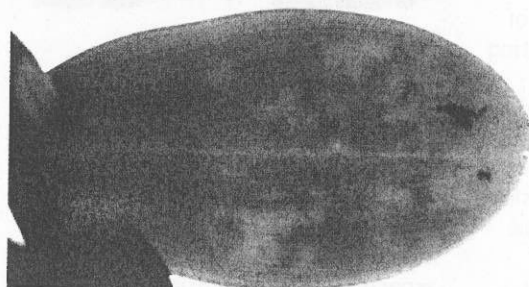


Fig. 3: *Phalaenopsis*, chlorotic mottling on leaves caused by *Cymbidium mosaic virus* (CyMV).

Photos (3): authors

the main virus pathogens causing serious yield losses.

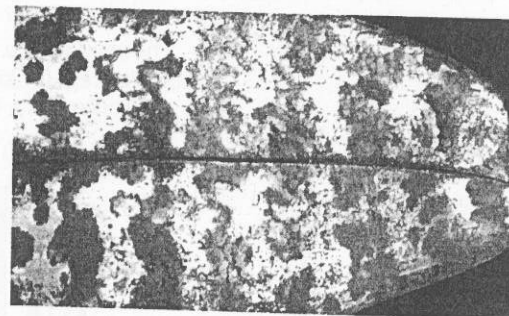
Four German orchid farms offered **healthy and diseased plants** (*Phalaenopsis*) for the experiments in the greenhouse and provided **samples of nutrient solution** from tables with diseased and healthy orchids. They allowed to test **leaf material** from three hundred plants to detect the main causal viruses.

orchids which were cultivated in the contaminated solution. All samples were tested by double sandwich ELISA [1].

Results

Tobacco mosaic virus (TMV), Cucumber mosaic virus (CMV), Tomato ringspot virus (ToRSV), Odontoglossum ringspot virus (ORSV), and Cymbidium mosaic virus (CyMV) were detected in virus

Fig. 2: *Phalaenopsis*, chlorotic and necrotic ringspots on leaves caused by *Odontoglossum ringspot virus* (ORSV).



Studies followed how fast viruses are released from roots of diseased plants while contaminating the irrigation water and infect healthy plants. All testplants were set up in the beginning while the irrigation system, constructed of four tables with channels for ebb-flow cultivation, was started (Fig. 1). Nutrient solution got naturally virus contaminated by growing virus infected orchids. The drained water was regularly (once per week) tested for viruses as well as healthy

diseased orchids and in nutrient solution taken from German farms.

The later two pathogens ORSV (Fig. 2) and CyMV (Fig. 3) were found as the main viruses causing serious yield losses of orchids and known to spread fast within the culture. We continued the infection experiments with these two pathogens. The detection of ORSV directly from recirculating irrigation water was successful after thirteen days (Fig. 4), at the same time it was possible to detect the virus in leaves of all originally healthy plants. CyMV was found in nutrient solution after five weeks and

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in leaves after two weeks (Fig. 5). The studies show that ORSV and CyMV are released from roots of diseased plants while contaminating the irrigation water and infect healthy plants within a short cultivation period. The results confirm the transmission of stable viruses by recirculating irrigation solutions as discussed by previous studies on different cultivars infected by TMV, CMV, ToRSV or other viruses [1]. Virus transmission by water is well known and demonstrated by several authors who studied virus spread by environmental waters [2, 3].

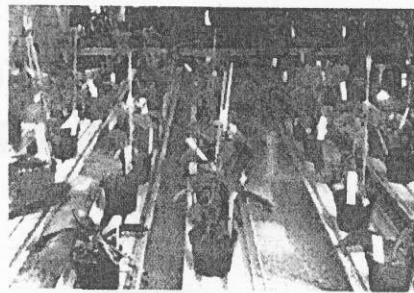


Fig. 1: Ebb-flow-system: set up of Phalaenopsis and herbaceous indicator plants.

In order to reduce and control virus transmission by nutrient solution some main aspects have to be considered. Beside the need of using virustested plants when building up a new culture, the disinfection is the most important treatment before and while growing the plants. It interrupts the pathway of viruses via tools and tables.

We investigated the effect of the disinfectance MENNO-Florades (Menno-Chemie-Vertrieb, Norderstedt, Germany) how far viruses are inactivated and found out that for table-desinfection a solution of 2 % enables the inactivation of ORSV within 14 hours (CyMV: 2 %, 30 minutes), for knife-desinfection a solution of 3 %

enables the inactivation of ORSV within 30 seconds (CyMV: 2 %, 30 seconds). The results base on biotests with 50 indicatorplants which were inoculated with diverse solutions of virus-desinfectants (1%-10%) and various incubation time (10 seconds-12 hours). All solutions were also tested by ELISA.

The possibility of virus inactivation by a chemical disinfecting method opens a new perspective to control virus transmission via tools and tables. The disinfectance is very easy to handle and has been applied in various concentrations of Florades dependant on the culture and the virus.

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Reference:

- [1] Büttner, C., K. Marquardt & M. Führling, 1995. Acta Horticulturae 396, 265-72.
- [2] Koenig, R., 1986. Advances in Virus Research 31, 321-33.
- [3] Büttner, C. & F. Nienhaus, 1989. Eur. J. For. Path. 19, 206-11.

Conclusions

The investigations on virusinfected orchids demonstrate the transmission and spread of several plantviruses by recirculating nutrient solution such as an irrigation ebb-flow-system. This system saves water and nutrition while recycling water, but at the same time it implicates the potential exists for spread of pathogens in reused water.

Transmisión mecánica de virus en las orquídeas

Una investigación del Instituto de fitomedicina de la Universidad de Berlín se ocupa de la transmisión de virus en el cultivo de las orquídeas a través del agua, las herramientas y las mesas. Los diversos virus proceden de establecimientos de producción. Además, también se intenta comprobar el efecto desinfectante que tiene Menno Florades sobre los diversos virus investigados.

Mechanische Übertragung von Viren bei Orchideen

Eine Untersuchung des Institutes für Phytomedizin an der Universität Berlin befaßt sich mit der Übertragung von Viren bei der Orchideen-Kultur durch Wasser, Werkzeuge und Tische. Die verschiedenen Viren stammen aus Produktionsbetrieben. Außerdem versucht man dabei abzulesen, welche desinifizierende Wirkung Menno-Florades auf die einzelnen, untersuchten Viren hat.

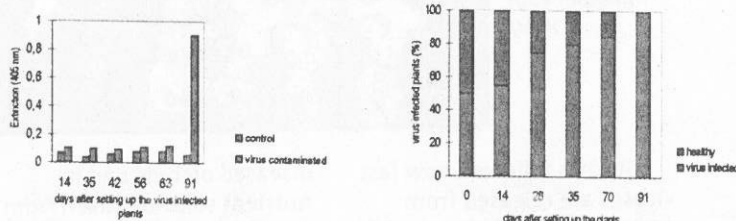


Fig. 4: Odontoglossum ringspot virus (ORSV): disease development by nutrient solution of the ebb-flow system. Left: detection of ORSV in nutrient solution. Right: detection of ORSV in leaves of Phalaenopsis.

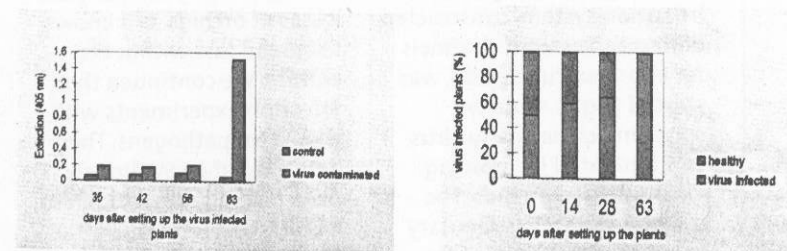


Fig. 5: Cymbidium mosaic virus (CyMV): disease development by nutrient solution of the ebb-flow-system. Left: detection of CyMV in nutrient solution. Right: detection of CyMV in leaves of Phalaenopsis.

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