Distribution and spread of *Pepino mosaic virus* (PepMV) in tomatoes cultivated in a re-circulating hydroponic system

A Fakhro, U Paschek, S von Bargen, C Büttner
Humboldt-Universität zu Berlin, Institute for Horticultural Sciences, Berlin, Germany
Email: fakhroah@student.hu-berlin.de

D Schwarz
IGZ, Großbeeren/Erfurt e.V., Theodor-Echtermeyer Weg 1, D-14979 Großbeeren, Germany

INTRODUCTION

Pepino mosaic potexvirus (PepMV), whose host range is mainly limited to Solanaceae (Salomone & Roggero, 2002), was initially described in 1974 as causal agent of a viral disease of pepino (*Solanum muricatum*) in Peru. The virus was detected in tomato plants (*Lycopersicon esculentum*) in 1980 (Jones *et al*., 1980), and in 1999 it was found in Europe infecting glasshouse tomatoes in the Netherlands (EPPO 2000; van der Vlught *et al*., 2000). Since this first report in the European Community, PepMV was placed on the EPPO Alert List. The virus was monitored during subsequent years and found in several European tomato-growing regions (including Belgium, the Canary Islands, France, Germany and Spain), predominantly in indoor cultivated tomato plants, but then eradicated (Roggero *et al*., 2001; EPPO, 2001). Because PepMV is easily transmitted by contact and propagation, and tomato is a major crop in Europe, putative ways of transmission of PepMV (as well as the susceptibility of tomato cultivars) have to be investigated in detail, to evaluate the pathogen as an invader and its potential to spread.

METHODS AND RESULTS

The susceptibility of several tomato cultivars to two different PepMV isolates (PepMV-Peru, DSMZ PV-0554 and PepMV-France, isolated from infected French tomato fruits) was tested in a glasshouse under different culture conditions. Two tomato plants of several different cultivars (e.g. Backmor, Counter F1, Hildares F1, T3, T7, T9, Rawan F1 and three local cultivars from Syria), were mechanically inoculated at the four-leaf stage. Plants were cultivated in standard soil and grown for 10 weeks in a glasshouse under natural light and a temperature regime of from 16 to 24°C. In parallel, four plants of seven different tomato cultivars (Balkonstar, Counter F1, Frühzauber, Gnom F1, Goldene Königin, Hildares F1 and Master F1) were planted in a re-circulating hydroponic system (nutrient solution after De Kreij *et al*., 1997) and grown for 12 weeks under 15 h light/9 h dark cycle (RH 60% and temperature ranging from 18°C (night) to 20°C (day). After inoculation with either PepMV-Peru or PepMV-France, plants were tested by DAS-ELISA. After three weeks, all inoculated tomato cultivars were PepMV positive in DAS-ELISA, but (compared with healthy control plants) only tomatoes grown in soil exhibited visible symptoms such as reduced growth and distorted leaves with chlorotic lesions (typical for a PepMV infection in tomato).

To investigate PepMV distribution via nutrient solution and spread in tomato, plants were grown in a re-circulating hydroponic system in a glasshouse for 14 weeks. Seedlings (cv.

Hildares) at the seven-leaf stage were planted in troughs with re-circulating nutrient solution (as described above). Plants were cultivated under global radiation of 32 MJ/m^2/d, 65 % RH, and mean daily temperatures of from 20 to 28°C. Seven non-inoculated test plants (separated from eight PepMV-infected tomato plants by 1 m spacing and an additional fleece), serving as inocula, were examined by DAS-ELISA for virus infection. Sampling for ELISA was carried out once a week, using roots and leaf sections as well as newly grown plant parts (such as inflorescences, fruits and leaves). During the experiment, no symptoms of PepMV infection were visible in tomato, although roots of test plants became infected two weeks after inoculation. Nine weeks after inoculation, PepMV was detectable in roots of all test plants, although the virus was not detectable in extracts of the nutrient solution, neither by DAS-ELISA nor by IC-RT-PCR. It was shown that PepMV was immediately transported within a newly infected plant to young leaves, inflorescences and developing fruits, whereas old leaves remained virus free. This demonstrates that long-distance transport of the virus inside an infected tomato plant is directed mainly to sink tissue. Furthermore, PepMV was shown to cause yield loss about 17% in infected plants after 11 weeks of plant cultivation.

The risk of PepMV transmission in glasshouse tomatoes grown in a re-circulating hydroponic system is quite high, because infected plants often display no significant symptoms (especially if grown under optimal conditions), so the pathogen can be easily spread unnoticed. Furthermore, many tomato cultivars are susceptible to PepMV, and infection by this virus can reduce yield significantly, particularly in PepMV-susceptible cultivars.

REFERENCES

De Kreij C; Voogt W; van den Bos AL; Baas R (1997). Voedingsoplossingen voor de teelt van tomaat in gesloten teeltsystemen. *Proefstation voor Bloemisterij en Glasgroente, Naaldwijk, Niederlande* **1** *(Auflage 22).*

EPPO (2000). *EPPO Alert List-Viruses. Pepino mosaic potexvirus – a new virus of tomato introduced into Europe.* www.EPPO.ORG/QUARANTINE/Alert_List/viruses/pzmxxx.htm

EPPO (2001). *EU survey on Pepino mosaic potexvirus.* www.maff.gov.uk/planth/pestnote/pepino.htm

Jones RAC; Koenig R; Lesemann DE (1980). Pepino mosaic virus, a new potexvirus from pepino (*Solanum muricatum*) *Annals of Applied Biology* **94**, 61-68.

Roggero P; Masenga V; Lenzi R; Coghe F; Ena F; Winter S (2001). First report of *Pepino mosaic virus* in tomato in Italy. *Plant Pathology* **50**, 798.

Salomone A; Roggero P (2002). Host range, seed transmission and detection by ELISA and lateral flow of an Italian isolate of *Pepino mosaic virus*. *Journal of Plant Pathology* **84**, 65-68.

van der Vlught RAA; Stijer CCMM; Verhoeven JTHJ (2000). First report of pepino mosaic virus on tomato. *Plant Disease* **84**, 103.