



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

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## Introduction

*Pepino mosaic virus* (PepMV) (Fig.1) was initially described as causal agent of a viral disease of Pepino (*Solanum muricatum* Ait.) in Peru 1974. Its host range is mainly limited to plant species within the family *Solanaceae* (Salomone and Roggero, 2002) and was detected in tomato plants (*Lycopersicon esculentum* Mill.) by Jones et al. in 1980 for the first time. In 1999 it was found in Europe as a virus disease of glasshouse tomatoes in the Netherlands. The virus was detected in the following years in several European tomato growing regions like Spain, France, Canary Islands, Belgium and Germany. Because *Pepino mosaic virus* is easily transmitted by contact and propagation and tomato is a major crop in Europe, putative ways of transmission of PepMV as well as susceptible tomato cultivars have to be investigated in detail to evaluate the pathogen as invading pest and its potential of spread.

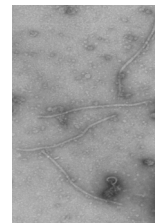


Fig.1 Electron microscopic picture of *Pepino mosaic virus* after negative contrasting with uranylacetate (40.000 fold).

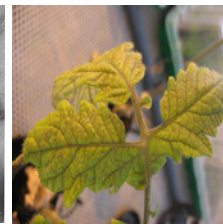


Fig.2 Leaf-symptoms (distortion and chlorotic lesions) induced by PepMV on tomatoes cultivated in soil in a pot system.



Fig.3 Dwarfing of PepMV infected tomato plants (right) in comparison with healthy control plant (left), 10 weeks after inoculation

## PepMV infection of tomato cultivars

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 under different conditions in a glasshouse. Tomato plants of different cultivars were mechanically inoculated, cultivated in standard soil and grown for 10 weeks in a glasshouse. In parallel, plants of seven different tomato cultivars were planted in a re-circulating hydroponic system and grown for 12 weeks. 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 (Fig.4) but only tomatoes grown in soil, exhibited visible symptoms compared with healthy control plants like reduced growth (Fig.3) and distorted leaves with chlorotic lesions (Fig.2), typical for a PepMV infection of tomato.

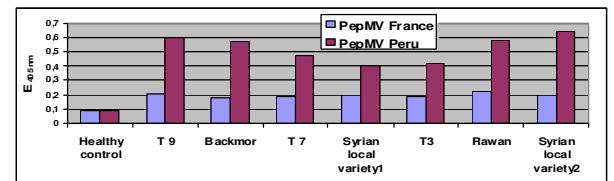


Fig.4 DAS-ELISA results from Syrian tomato cultivars grown in soil and infected with two PepMV isolates (from France and Peru). Extinction values (E<sub>405</sub> nm) are shown as arithmetic means (n=4), measured after 16 h substrate incubation.

## Distribution and spread of PepMV in a hydroponic system

To investigate PepMV distribution via nutrient solution and spread in tomato, plants were grown in a re-circulating hydroponic system in a glasshouse experiment for 14 weeks. Seedlings (cv. Hildares) at seven leaf stage were planted in troughs with recirculating nutrients solution. Seven non inoculated test plants, separated by 1 m spacing and an additional fleece from eight PepMV infected tomato plants serving as inocula were examined by DAS-ELISA for virus infection (Table.1). Sampling for ELISA was carried out once a week from roots and leaf sections as well as new grown plant parts, like inflorescences, fruits and leaves. During the experiment no symptoms of PepMV infection were visible in tomato though roots of test plants were infected two weeks after inoculation for the first time. Nine weeks after inoculation, PepMV was detectable in roots of all test plants although the virus was not detectable in nutrient solution extracts neither by DAS-ELISA nor by IC-RT-PCR. It could be shown, that PepMV was immediately transported within the newly infected plant to young leaves, inflorescences and developing fruits, while old leaves remained virus free (Fig.5). 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.

Tomato cultivars grown in hydroponic system	PepMV France	PepMV Peru	Tomato cultivars grown in soil	PepMV France	PepMV Peru
Healthy control	-	-	Healthy control	-	-
Hildares F1	+	+	T 3	+	+
Goldene Königin	+	+	T 7	+	+
Muster F1	+	+	T 9	+	+
Frühzauber	+	+	Rawan	+	+
Balkonstar	+	+	Syrian lokal variety 1	+	+
Gnom F1	+	+	Syrian lokal variety 2	+	+
Counter F1	+	+	Backmor	+	+
			Counter F1	+	+
			Hildares F1	+	+

Table.1 Summary of DAS-ELISA results of different tomato cultivars three weeks after inoculation with two PepMV isolates (France and Peru). (+ = positive reaction in ELISA, - = negative).

## Conclusion

Many tomato cultivars are susceptible to PepMV and this virus infection can reduce yield significantly, particularly in PepMV susceptible tomato cultivars.

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.

## References

- Jones et al. (1980). Pepino mosaic virus, a new potyvirus from pepino (*Solanum muricatum*). *Ann. Appl. Biol.* **94**, 61-68
- Salomone and Roggero (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

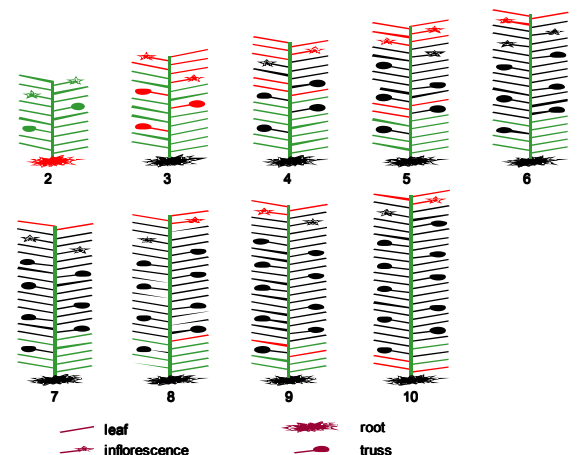


Fig.5 Spread of PepMV within tomatoes infected via roots during 10 weeks of cultivation  
2 - 10 = week after start of the experiment  
green = healthy plant organ (stem was not investigated)  
red = PepMV-infection when tested positive the first time  
black = PepMV-infection tested positive already in former weeks