Plum-Pox Virus Incidence in Serbian Temerin Municipality

A szilvahimlő-vírus fertőzöttség mértéke a délvidéki Temerinben

Ferenc Bagi*, Goran Barać, Djina Konstantin, Andor Majoros and Renata Iličić

University of Novi Sad, Faculty of Agriculture, Serbia; goran.barac@polj.edu.rs, djinakonstantin@gmail.com, majorosandor98@gmail.com, renata.ilicic@polj.edu.rs

**Correspondence: ferenc.bagi@polj.uns.ac.rs*

Abstract: During two years of research, incidence of *Plum pox virus* (PPV, sharka disease) on roadside and backyards *Prunus* trees was determined. Altogether 50 samples were analysed by DAS-ELISA technique. All 35 analysed plum trees proved to be infected (35/35), in case of myrobalan plum four samples were infected (11/4), apricot one (3/1) and one collected peach sample was healthy (1/0). These results confirm the widespread presence of *PPV* both on plants with clear symptoms, but also on symptomless *Prunus* species and underline the necessity of growing tolerant or hypersensitive cultivars.

Keywords*: sharka; Plum pox virus; Prunus; tolerant cultivars*

Összefoglalás: Kétéves kutatás során a szilvahimlő virus elterjedését vizsgáltuk a délvidéki Temerin községben. A levélmintákat az útszéli és kiskerti csonthéjasokról gyűjtöttük. Összesen 50 mintát vizsgáltunk DAS ELISA szerológiai módszerrel. Minden megvizsgált szilvaminta fertőzöttnek bizonyult (35/35), a ringló esetében négy minta fertőzött volt (11/4), a sárgabarack esetében a begyűjtött, illetve fertőzött növényminták aránya 3/1, míg az egyetlen őszibarack minta egészségesnek bizonyult. Az eredmények a vírus széleskörű jelenlétét igazolják, ami szükségessé teszi a toleráns fajták termesztésének szükségességét.

Kulcsszavak*: szilvahimlő; Plum pox virus; Prunus; toleráns fajták*

1. Introduction

Plum pox virus is one of the most important member of genus *Potyvirus*. The main host plant is the plum (Barba et al., 2011), but it can infect other grown stone fruit species (apricot, peach, almond, sweet cherry, sour cherry), ornamental plants or wild *Prunus* species grown spontaneously beside roads or parks (myrobalan plum, blackthorn, etc.). According to Jevremović and Paunović (2014) the infection level by sharka disease in some Serbian orchards can reach 80%. Emergence of the virus in Serbia caused economically important losses and reduced the plum production, since the very popular autohtone plum cultivar Požegača is extremely susceptible to virus infection. In 18 century plum was very important export merchandise and contributed to state economy (Demeter, 2016). The anisometric shaped virus is transmitted mechanically and by number of aphid species on non-persistent manner (Levy et al., 2000). Since the transmission time is very short, the infection of healthy trees happens even if the tree was previously treated by insecticides. Another important way of virus spreading is the infected propagation material. Also an important way of virus spreading is grafting, so the

propagation material becomes infected if the rootstock or scion is infected. There are about 10 different virus strains, among them very important are PPV-D (Dideron), PPV-M (Marcus) and PPV-Rec (recombinant) (James et al., 2013). Strains can be differentiated by molecular tools, but from practical standpoint it is important that the strains differ in their pathogenicity toward different stone-fruit species, the symptoms on host plants can also be different and the transmission efficiency by different aphid species (Serçe et al., 2009).

2. Materials and Methods

Leaf sample collection from roadside or backyard *Prunus* species was carried out in 2021 (twenty sample) and 2023 (thirty). During the first year of research the samples were taken from plum (five samples), apricot (three samples), myrobalan plum (11 samples) and peach (1 sample). In the second year of research we were focused on roadside or backyard grown plums, so all thirty samples originated from plum trees. During sample collection the tree`s GPS position was determined and the samples coded. All samples were kept on +4 ºC-on until the serological analysis.

DAS ELISA kit produced by Loewe Biochemica GmbH was used to analyse the samples. After the measurement of 0,25 g of leaf tissue and homogenisation in the extraction puffer the standard DAS ELISA protocol was followed (Clark and Adams, 1977).

After incubation of leaf tissue with specific antibody and conjugated specific antibody the positive samples were detected by BioTek Epoch spectrophotometer. The values were compared to positive and negative controls. All samples with spectrophotometric value above double value of negative controls average were considered as positive.

3. Results and Discussion

On the basis of the results of the serological analysis high *Plum pox virus* incidence can be determined in Temerin locality: during first year of investigation all the analysed plum trees were infected (5/5), in case of apricot one tree (3/1), myrobalan plum four (11/4) were infected, and the only one peach sample was virus-free. During the second year of research all collected plum samples from Temerin roadside or backyard proved to be infected (30/30).

On infected plum trees typical ringspots and mosaic symptoms can be observed (Figure 1 and Figure 2). The symptoms depend from plum cultivar, virus strain and ecological factors too. Fruits from infected trees regularly have less sugar content and other fruit quality parameters are reduced (Kensaku et al., 2020).

Figure 1. *Typical ringspots on plum leaves caused by Plum pox virus*

Figure 2. *Mosaic symptoms of Plum pox virus infected plum leaves*

While in case of infected plum trees the symptoms can be easily discovered in case of myrobalan plum even the symptomless trees proved to be infected. These findings can be very important from the standpoint of virus (sharka) disease control, since in the case of eradication measures it is not enough to destroy the trees with visible symptoms. It is necessary to test all *Prunus* species and destroy all sources of inoculum. Wild or ornamental *Prunus* species often can be the host of virus and serve as virus inoculum source.

This kind of high *Plum pox virus* incidence is not typical just for the Temerin region, but also for regions of the province Vojvodina (Bagi et al., 2021). From practical standpoint it means that the old, autochtone, but very virus susceptible cultivars like Pozegaca can not be grown, but also it means that even in the case of planting virus –tested or virus free planting material, the newly planted orchard after few years became infected, because of broad existence of virus source.

Non-persistent or stylet-borne manner of virus transmission and possibility that different aphid species are capable of virus transmission are facts which makes control measures, (like use of insecticides) uneffective. Basic control measures, like planting a virus tested plant material is still essential, but because of the broad presence of infected *Prunus* species is not a long term solution. There are a number of examples in plant pathology history that eradication measures on some regions, even countries can be effective. In Brasil more than 4 million citrus trees were destroyed to prevent losses from CTV (Citrus tristeza vírus) (Fadel et al., 2018). Similar measures were effective against PPV in Puglia region in Italy (Boscia, pers. com.).

Canada spent 125 million dollars from 2001 for destroying the PPV infected trees and producers compensations (Wang et al., 2006). In Serbia eradication measures were taken in the municipality of Lazarevac.

Without possibility of producer compensation on state or region level after eradication, and in the case of widespread presence of virus infection, the solution can rely just on plant breeding. Since the virus resistance is multigenic (Levy et al., 2000), the traditional breeding programs worked on breeding of tolerant or hypersensitive cultivars (Neumüller et al., 2010). Tolerant stone fruit cultivars secures relatively stable and quality yield even after *Plum pox virus* infection. Hypersensitive cultivars are reacting by necrosis of infected tissue and in this way prevents the spreading of virus to uninfected plant parts. Planting of tolerant cultivars is in some way a coexistence with the virus, since the tolerant, infected trees are also a further source of infection. In some countries by tools of molecular genetics, the genes which are coding the virus coat protein are inserted in the plant genome. In that way transgenic plants became resistant to plant virus (Malinowski et al., 2006).

5. Conclusions

In the Province of Vojvodina every condition for plum pox virus outbreaks exists, since virus and the susceptible hosts are widespread, and the climate is favourable for vector transmission. Among plant protection measures growing of tolerant stone fruit cultivars and planting of virus tested plant material can moderate the economic losses.

Acknowledgements

This research and publication were supported by"Délvidékért Kiss Foundation" through the assistance of the Hungarian Academy of Science.

References

Bagi, F., Barać, G., Iličić, Z., Burmazović, M., Meszaros and V., Popović, T. 2021. *Plum pox virus* infection level in *Prunus* species growing along roadsides or in backyards in Vojvodina province. *Pesticidi i fitomedicina*. **36** (3) 111–118. https://doi.org/10.2298/PIF2103111B

Barba, M., Hadidi. A., Candresse. T. and Cambra, M. 2011. *Plum pox virus.* pp: 1–7. *In*: Hadidi, A., et al., (eds.) Virus and virus - like diseases of pome and stone fruits. APS Publications. https://doi.org/10.1094/9780890545010

Clark, M. F. and Adams, A. N. 1977. Characteristics of the microplate method of enzymelinked immunosorbent assay for the detection of plant viruses. *Journal of General Virololgy*. **34** 475–483. https://doi.org/10.1099/0022-1317-34-3-475

Demeter, G. 2016. A Balkán és az Oszmán Birodalom III. Társadalmi és gazdasági átalakulások a 18. század végétől a 20. század közepéig Szerbia, Macedónia, Bosznia. Budapest-Debrecen, MTA BTK, 78.

Fadel, A. L., de Assis Alves Mourão Filho, F., Stuchi, E. S., Wulff, N. A. and Zarate Couto, H. T. 2018. Citrus sudden death-associated virus (CSDaV) and citrus tristeza virus (CTV) in eleven rootstocks for 'Valência' sweet orange. *Defesa Fitossanitária, Rev. Bras. Frutic*. **40** (4) 1–6. https://doi.org/10.1590/0100-29452018788

James, D., Varga, A. and Sanderson, D. 2013. Genetic diversity of *Plum pox virus:* strains, disease and related challenges for control. *Canadian Journal of Plant Pathology*. **35** (4) 431–434. https://doi.org/10.1080/07060661.2013.828100

Jevremović, D. and Paunović, S. 2014. *Plum pox virus* strains: Diversity and geographical distribution in Serbia. *Pesticidi i fitomedicina.* **29** (2) 97–107. https://doi.org/10.2298/PIF1402097J

Kensaku, M., Masayoshi, H., Yuka, H., Akio, M. and Masanobu, N. 2020. Intra strain biological and epidemiological characterization of *Plum pox virus. Molecular Plant Pathology*. **21** (4) 475–488. https://doi.org/10.1111/mpp.12908

Levy, L., Damsteegt, V., Scorza, R. and Kolber, M. 2000. *Plum pox potyvirus* disease of stone fruits. APSnet Features. https://doi.org/10.1094/APSnetFeature-2000-0300

Malinowski, T., Cambra, M., Capote, N., Zawadska, B., Gorris, M. T. Scorza, R. and Ravelonadro, M. 2006. Field trials of plum clones transformed with the *Plum pox virus* coat protein (PPV-CP) gene. *Plant Disease*. **90** 1012–1018. https://doi.org/10.1094/PD-90-1012

Neumüller, M., Hartmann, W., Petruschke, M. and Treutter, D. 2010. The hypersensitivity resistance of european plum to the *Plum pox virus* and its potential impact on the epidemiology of the virus. 21st International Conference on Virus and other Graft Transmissible Diseases of Fruit Crops. Julius-Kühn-Archiv. 427 147–150.

Serçe, Ç.U., Candresse, T., Svanella-Dumas, L., Krizbai, L., Gazel, M. and Çağlayan, K. 2009. Further characterization of a new recombinant group of *Plum pox virus* isolates, PPV-T, found in orchards in the Ankara province of Turkey. *Virus Research*. **142** 1-2 121–126. https://doi.org/10.1016/j.virusres.2009.01.022

Wang, A. Sanfaçon, H., Stobbs, L. W., James, D., Thompson, D., Svircev, A. M. and Brown, D. C. W. 2006. *Plum pox virus* in Canada: progress in research and future prospects for disease control. *Canadian Journal of Plant Pathology*. **28** (2) 182–196. https://doi.org/10.1080/07060660609507286