ACTA MICROBIOLOGICA BULGARICA Volume 33 / 4 (2017)

Manifestation of Practical (Field) Resistance of Apricot (*Prunus armeniaca*) to Plum Pox Virus (*Sharka Virus, PPV*)

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Abstract

The investigation was aimed at the receptivity and possible reactions of apricot (*Prunus armeniaca*) to plum pox virus (*sharka virus, PPV*) widely spread not only in the orchards but in the uncultivated terrains on the territory of Bulgaria, where fruit trees of the genus *Prunus* grow.

Field observations of manifestation of plum pox (sharka) disease were carried out during the period of 2015–2017. They covered trees of plum (*P. domestica*), wild plum (*P. cerasifera*), peach (*P. persica*) and apricot (*P. armeniaca*). Apricot seedlings grown in the yard nearby the Plant Protection Department of ISSAPP were also included in the investigation. The seedlings originated from pits with and without sharka symptoms. A double antibody sandwich enzyme linked immunosorbent assay (DAS ELISA) was used for detecting the viral pathogen.

The spread of plum pox disease was visually identified in all investigated orchards. Plum trees were the most contaminated. Single cases of sharka on wild plum, peach and apricot trees were also observed. During the period of investigation apricot seedlings remained healthy and the results of DAS ELISA were negative. Apricot seedlings were not receptive to PPV in field conditions when the insects (aphids) were natural vectors of the viral infection. The apricot trees could have been infected through infected rootstock (*P. cerasifera*). The results confirmed that apricot generative posterity remained free of PPV.

Key words: apricot, plum pox, PPV

Резюме

Изследването е насочено към установяването на инфекция от вируса на шарката (PPV) при кайсията и възможните реакции на този вид към него. PPV е широко разпространен не само в градините, но и в некултивираните площи на територията на България, където растат дървета от род Prunus. Проведени са полски обследвания в периода 2015 – 2017 година в района на общинитге Божурище и Костинброд. Обследванията обхващат дървета от видовете слива (*P. domestica*), джанка (*P. cerasifera*), праскова (*P. persica*) и кайсия (*P. armeniaca*). В изследването също са включени кайсиеви семеначета, отгледани в двора на направление „Защита на растенията" към ИПАЗР.

Семеначетата произхождат от кайсиеви костилки, някои от които с признаци на шарка и други без признаци. Вариантът „двоен антитялов сандвич" на имуноензимния сорбентен тест (DAS ELISA) е използван за откриването на PPV.

Шарката е установена визуално във всички обследвани участъци. Най-често признаците се наблюдават по сливовите дървета. Единични случаи са открити при джанка, праскова и кайсия. Заразата при кайсиевите дървета вероятно е дошла от заразената джанкова подложка. Кайсиевите семеначета в осемгодишния период на изследването не са заразени от PPV. Това показва, че генеративното потомство на кайсията в естествени условия, където има насекомни преносители на заразата, не е възприело PPV.

Introduction

The virus disease sharka on plums or plum pox has been established on a number of drupaceous fruit species all over the world (Dulić and Sarić, 1986; Kalašan and Bilkej 1989; Kegler and Hartmann, 1998; Fujiwara *et al*., 2011). In Bulgaria, the disease endangers mostly the plum,

peach and apricot. The fruits of infected trees of the above mentioned species may drop prematurely. The marketable appearance of those remaining on the trees deteriorates due to specific deformations. The pulp undergoes undesirable changes, thus making the fruits unsuitable for fresh consumption and processing. The PPV infection may cause drying of branches in some plum cultivars that are sensitive to the pathogen.

The damages that are likely to be caused by sharka impose the need of a respective disease control. At present, preventive disease control is the most important measure. It can be achieved by spatial isolation from the primary sources of infection, imposition of quarantine, prompt eradication of already infected trees and application of insecticides against disease vectors, i.e. aphids (Atahasoff, 1933; Grigorov, 1980).

The disease has been known for a long time in Bulgaria and is spread in almost all areas of the country, where drupaceous fruit species can be grown. The most important characteristics of the fruit cultivars are their PPV resistance or tolerance. That is why the issue of receptivity of separate species of the *Prunus* genus to PPV is important both from the theoretical and practical point of view (Iliev and Stoev, 2002; Iliev *et al*., 1999; 2011).

Materials and Methods

The study was carried out on apricot seedlings, grown in the yard of the Plant Protection Department of SSAPP „Nikola Pushkarov". The seedlings were grown from pits of apricot fruits without superficial symptoms of sharka. The fruits were purchased from a farmer's market intended to be consumed as fresh dessert. Whitish ring spots, typical of sharka, were found only on the shells of several pits.

The collected pits, with or without sharka symptoms, were sown in the open in the spring of 2010 (Table 1). The five seedlings that grew from them were not treated with insecticides against PPV transmitting aphids even though sharka was common in the area.

A virus DAS ELISA test of leaf samples from each seedling without sharka symptoms was made at the end of May, 2017 (Adams, 1978; Kamenova and Stoev, 1987). The diagnostic reagents of LOEWE Biochemica GmbH were used for the test, according to the company's instructions. Optical density was recorded upon completion of the test with spectrophotometer Multimode Detector DTX 880 at a wave length of 405 nm. The extinction values exceeding the negative control at least three times were assumed positive. The positive control for the test was a leaf sample with sharka symptoms from a plum seedling.

Results and Discussion

The examination of the seedlings in 2010–2017 did not find any aphids invasion on the leaves. No sharka symptoms were found during the same period. The DAS ELISA data were negative for all samples*. There was a positive result only for the sample of a plum seedling with sharka symptoms, grown on the same plot of ISSAPP (Fig. 1, No 15).

The lack of aphids infestation in all seedlings showed that they were not attractive to those insects, known as PPV vectors. Possibly, they were not susceptible to the pathogen due to the hypersensitivity of the leaf tissue to PPV. In this case, a pricking by the stiletto of the virophorous insect might cause micronecrosis in the pricking spot. This prevents the spread of the infection in the leaf, hence, in the plant organism.

The transmission of PPV to generative posterity in drupaceous fruit trees and more specifically apricot has been targeted by a number of studies because of the importance of the results from theoretical and practical point of view. The data in the present paper are in conformity with those of Pertrov (2014).

The lack of infection does not mean that apricot cannot be infested with PPV. There is in-

Table 1. Objects of the investigation

Total number of sown pits –10	Total number of grown seedlings - 5	
	grown seedlings	sharka symptoms
Pits with sharka symptoms – 5	2	-
Pits without sharka symptoms – 5	3	-

* Apples are not host plants of PPV. They were tested as additional control.

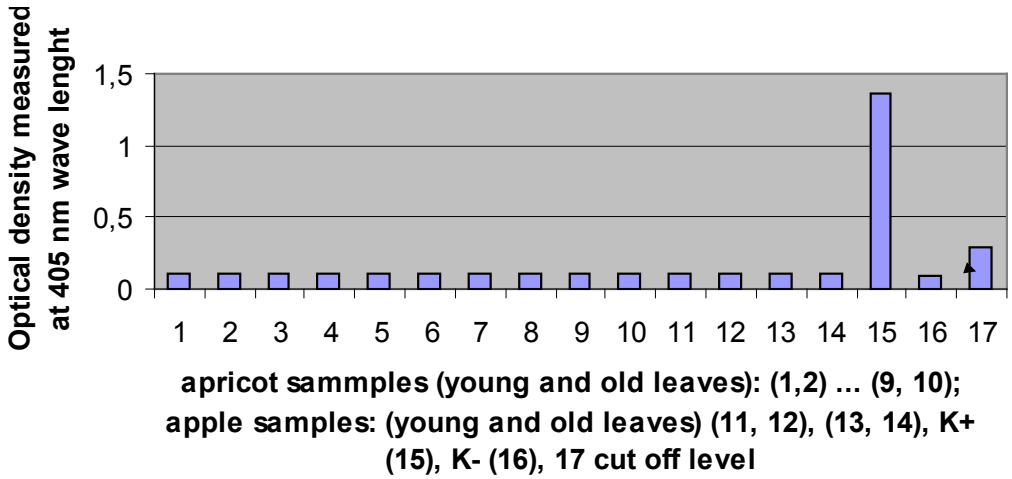

Fig. 1. Lack of infection in apricot seedlings in an area with widespread plum pox

There are three basic explanations of the negative results:

- neither of the seedlings were infected with PPV during the period of study;
- non-infected plants grew from the pits with sharka symptoms;
- the embryos of both pits with sharka symptom on the shells remained virus free and the seedling were not infected.

formation in specialized sources about the spread of sharka in apricot orchards and economic losses suffered by fruit farmers. One of the possible reasons of infection could be the grafting of the apricot cutting on infected rootstock in the process of tree production (Šutić, 1964; Trifonov, 1972; Milusheva and Kamenova, 2006).

The susceptibility of apricot to PPV as well as the reaction to this pathogen depends on the viral strain characterization, cultivar of the apricot tree and aphids' species (Kegler and Hartmann, 1998; Kamenova *et al.,* 2003; Kamenova, 2015). The data of the present study drew our attention to the so-called practical resistance, also known as field resistance. Practical resistance means that the cultured plant is not infected by the pathogen under certain conditions, known to the farmers. People can create such conditions by studying the strain composition of the pathogen, the cultivars' response to it and the species in the aphid population. When the strains of PPV to which apricot cultivars are tolerant, are known or there are no aphids to transmit the virus, new profitable plantations can be created.

The first mention of sharka in specialized scientific literature dates back to 1933 by Atanasoff in Bulgaria. The disease became the reason for the diversification of the list of plum cultivars due to the susceptibility of the then traditional cultivar Kyustendilska sinya sliva to PPV. New cultivars, resistant or tolerant to the pathogen, were created or introduced for the new orchards. This contributed to minimizing the losses to PPV that is spread all over the country (Trifonov, 1972; Iliev *et al.*, 1999).

The results of the studies conducted in the last quarter of the 20th and beginning of the 21st century defined PPV as the most dangerous for plum trees in the conditions of Bulgaria. This does not exclude the need for constantly monitoring the infectious background composition of newly created plantations. PPV remains the target pathogen in breeding new cultivars for resistance.

Conclusion

The apricot seedlings that developed in the conditions of a natural infectious background remained non-infected 8 years after sprouting. This could be explained as a manifestation of practical resistance. It can be used for preliminary screening among the plants of generative posterity of the apricot. Selected plants with valuable economic qualities that remain virus free could be propagated in a vegetative way. The vegetative posterity will serve further to validate new cultivars and rootstock for practical purposes.

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