EFFECT OF PLUM POX POTYVIRUS (PPV) ON YIELD EFFICIENCY OF SELECTED PEACH CULTIVARS

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Abstract

In 2001 PPV positive and PPV negative trees of different peach cultivars were selected based on the results of DAS-ELISA performed in spring. Re-testing of trees in spring 2002 showed rapid spread of infection, therefore we presume that most of the positive trees included in the evaluation were in the early stage of PPV infection. Statistically significant differences were found between yield efficiency (kg of fruits per 1 cm² of trunk cross-section area) of healthy and PPV infected trees in 2001 and 2002. In average of studied cultivars productivity of infected peach trees decreased for approximately 17%.

Key words: peach, Plum pox potyvirus, productivity, sharka

Introduction

Sharka, caused by the Plum pox potyvirus (PPV), is the most devastating viral disease of stone fruits. The severity of symptoms is influenced by host species and cultivar and, to a lesser degree, by climate, nutrition and growth of the trees, their age, the viral strain, etc. (Desvignes 1999). There are a lot of data about the influence of PPV infection on plums and apricots. In susceptible plum cultivars PPV infection can cause almost complete yield loss due to premature fruit dropping and diminished fruit quality (Németh 1986, 1994). Much less is known about the impact of PPV infection on peaches, although an isolate of PPV-M from France has been reported to produce necrosis in peach leaves causing leaf drop and dieback (Levy et al. 2000). Since peach is the most important stone fruit in Slovenia and the

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presence of sharka has been established in all stone fruit producing areas, the effect of PPV infection on productivity of several peach cultivars was studied in 2001 and 2002. Results are presented in the paper.

Materials and methods

In spring 2001 numerous peach orchards throughout Slovenia were screened visually for the presence of sharka symptoms. Orchards where trees exhibiting symptoms and symptomless trees were observed were sampled. Samples were analyzed for the presence of PPV using DAS-ELISA (Bioreba). Based on the serological results PPV positive and PPV negative trees were selected for each cultivar on every location. In 2001 altogether six cultivars at five different orchard locations could be evaluated. Two selected cultivars from an orchard on location Pohorski dvor could not be evaluated in 2001 due to the yield loss caused by severe spring frost. In spring 2002 DAS-ELISA (Bioreba) for detection of PPV was repeated. In addition, the presence of PPV-M was tested by TAS-ELISA (Agritest). Due to the severe yield loss caused by spring frost and due to the quick spread of infection, which caused a loss of healthy trees at some orchard locations, only three cultivars at three different orchard locations could be evaluated in 2002.

Yield of individual trees and trunk circumference 40 cm above the ground were measured. Yield efficiency (kg of fruits per cm² of trunk cross-section area) was calculated, multiplied by 100 and statistically analyzed with multifactor analysis of variance separately for 2001 and 2002. Health status (healthy vs. infected trees) and trial (determined as one cultivar at one orchard location) were used as main factors. Interactions among main factors were included in individual analyses. The relation between trunk circumference and yield as well as the relation between health status and trunk circumference were analyzed by regression analysis (linear model). STATGRAPHICS Plus version 3.2 program was used for statistical analyses.

Results

PPV-M, one of the two major subgroups of isolates (Candresse et al. 1998), was detected in all PPV positive trees. 44 percent of trees with negative results in 2001 were positive for PPV-M in 2002. This result shows a rapid spread of PPV-M infection in studied peach orchards.

High variability among healthy as well as among infected trees was observed within trials, i.e. within individual cultivars at individual orchard locations. Trees varied in their yield and vigour. Trunk circumference was used as a vigour indicator, since it is known to be strongly correlated with the dimensions of crown volume. Trunk circumference did not prove to be significantly dependent on health status (healthy vs. infected) (p = 0.8408). Based on these results we conclude that PPV infection did not have a significant effect on the tree vigour.
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Fig. 1. Mean yield efficiencies (kg of fruits per 1 cm$^2$ of trunk cross-section area) × 100 of healthy and infected trees in individual trials (determined as one cultivar in one location) in 2001: 1 – cv. ‘Redhaven’, location Koron, planted in 1988 (five healthy and five infected trees), 2 – cv. ‘Suncrest’, location Bric, planted in 1993 (five healthy and five infected trees), 3 – cv. ‘Simphonie’, location Bric, planted in 1993 (five healthy and five infected trees), 4 – cv. ‘Fayette’, location Peršič, planted in 1995 (five healthy and five infected trees), 5 – cv. ‘Norman’, location Kodrič, planted in 1997 (five healthy and four infected trees), 6 – cv. ‘Veteran’, location Kodrič, planted in 1997 (five healthy and four infected trees), 7 – cv. ‘Veteran’, location Lojk, planted in 1998 (five healthy and five infected trees).

Fig. 2. Mean yield efficiencies (kg of fruits per 1 cm$^2$ of trunk cross-section area) × 100 of healthy and infected trees in individual trials (determined as one cultivar in one location) in 2002: 4 – cv. ‘Fayette’, location Peršič, planted in 1995 (nine healthy and nine infected trees), 6 – cv. ‘Veteran’, location Kodrič, planted in 1997 (six healthy and seven infected trees), 8 – cv. ‘Veteran’, location Pohorski dvor, planted in 1995 (five healthy and eight infected trees), 9 – cv. ‘Royal Glory’, location Pohorski dvor, planted in 1995 (11 healthy and 11 infected trees).
The fact that more vigorous trees have larger crowns and therefore higher potential yields was confirmed in our study, since yield proved to be significantly dependent on trunk circumference ($p = 0.0000$). To minimise the effect of differences in crown volumes on the estimation of tree productivity, yield efficiency (kg of fruits per cm$^2$ of trunk cross-section area) was chosen for evaluation. This could be done, since health status did not have a significant effect on tree vigour.

Multifactor analyses of variance (factors: health status and trial) proved statistically significant lower productivity of infected trees in both studied years. Mean yield efficiencies of healthy and of infected trees in individual trials are presented in Figures 1 and 2. In average of studied cultivars productivity of infected peach trees decreased for approximately 17%. Differences among trials were also statistically significant in both years.

**Discussion**

Analysis of a large number of PPV isolates has permitted the identification of two major subgroups of strains, PPV-M and PPV-D, and two minor subgroups, PPV-EA and PPV-C (Candresse et al. 1998). The PPV strains differ in pathogenicity, host range, aphid transmissibility and geographic distribution (James and Varga 2003). PPV-M subgroup of isolates was reported to be more aggressive on peach and to spread more rapidly then PPV-D (Roy and Smith 1994). Isolates of PPV-M subgroup have been associated with fast spreading outbreaks in peach orchards also by Dallot et al. (2001). This finding has been confirmed in our study, since 44% of trees with negative results in 2001 showed the presence of PPV-M in the following year.

The observed fast spreading of PPV-M in studied orchards indicates that most of the studied diseased peach trees were in an early stage of PPV infection. Newly infected trees show scarce symptoms, usually only on a part of a tree. With passing years the infection of trees increases (Trifonov 1975), therefore yield losses higher than the ones observed in our study could be expected on trees infected for a longer period of time.

Apart from the duration of infection and viral strain, cultivar, the age of trees, their nutrition and growth and weather conditions have a significant effect on severity of symptoms (Desvignes 1999). This fact explains the large and statistically significant differences among trials, observed in both years, since six cultivars on five different orchard locations were studied in seven trials in 2001 (Fig. 1) and three cultivars on three different locations in four trials in 2002 (Fig. 2). Orchards also varied considerably in age.

PPV-M infection did not have a significant effect on the tree vigour in studied orchards in Slovenia. Desvignes (1999) also states that PPV has little effect on tree vigour. In contrast, a 21–38% growth and trunk circumference decrease was observed in Romania on infected plums (Németh 1994). Similar decrease of trunk circumference was observed on infected five-year-old apricot trees in Hungary (Németh 1994).
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Literature


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