Influence of infection of a tree by *Plum pox virus* on further spread of the disease within a plum orchard

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ABSTRACT: Occurrence of plum pox disease after natural infection was continually monitored between 1993 and 2000 in an experimental planting of plum trees where cultivars and hybrid seedlings were evaluated. All trees after finding symptoms of this disease were immediately grubbed. Summarization of the results has proved that infection of a tree significantly increased the risk of infection of neighbouring trees despite the fact that all infected trees were discarded. In the case of adjoining trees nearby, those within the same row increased their hazard by approximately three times and those between rows doubled their hazard in comparison with the average rate of infection of plum trees by PPV. This fact also highlights the significance of timely grubbing of affected trees immediately after an appearance of symptoms of this viral disease.

Keywords: PPV; rate of infection; plum orchard; spread of PPV

Plum pox is the most dangerous disease for the species and economically the most harmful for plum production. The disease is transmitted by grafting and by aphids (STANLEY 1996).

A major part of the territory of the Czech Republic, including the most important production districts, is infested by plum pox. The absolute majority of trees of the by far most widespread cultivar – Domestic plum, which often grows practically anywhere, is infected by this disease. Also wild growing plums are almost completely infected by PPV in most regions there (BLAŽEK et al. 1994; PAPRŠTEIN et al. 1994; POLÁK 1997, 1999).

Given these conditions with regard to a new plum orchard that is established by using virus-free planting material, the trees are infected by plum pox at a rate of 1–3% per year (BLAŽEK et al. 1994, 1995; BLAŽEK, KAREŠOVÁ 1998). If a part of the planted trees is already affected by plum pox or newly infected trees are not immediately removed, the rate of plum pox spreading in the orchard is much higher (GRZYB 1984; KAREŠOVÁ, SVOBODOVÁ 1997; ZAWADSKA et al. 1998).

The risk for a healthy tree to be infected is increasing (sometimes almost exponentially) the shorter its distance from an infected tree. PPV is most rapidly spread if a healthy tree is directly adjacent to a tree infected by the virus. In the case that this healthy tree grows in the vicinity of several trees infected by PPV, and in addition belongs to a clone of Domestic Prune, which is very susceptible to plum pox, the probability of its infection by the virus within one growing season equals nearly 1. With the increase of distance from the source of infection, the danger of infection of a healthy tree by PPV rapidly decreases. The critical distance determining reasonable safety seems to be probably no greater than 30–50 m, and may depend on such factors as age or size of trees (BLAŽEK et al. 2000).

The purpose hereof was to study the occurrence of a newly infected tree by plum pox in a plum orchard in relation to the distance from the source of infection or the last occurrence of a newly infected tree by this disease.

MATERIALS AND METHODS

An experimental orchard was located at Holovousy, Eastern Bohemia; the locality has an average annual temperature of 8.1°C, average rainfall of 650 mm, and altitude of 300 m. The orchard was planted step by step between the years 1992 and 2000 with spacings of 5 × 1 m to 5 × 3 m. The total number of trees was increased from about 500 in 1993 to 2,030 in 2000. This planting included mostly hybrid seedlings on own roots as well as different clonal material that belonged to several cultivars, mostly Domestic Prune, budded or grafted on various rootstocks (mostly Myrobalan seedlings or St. Julien A). The orchard was maintained with clean herbicide strips under the tree canopies and with grass along the alleyways. Fertilizing and spraying (based on integrated plant protection) conformed with normal commercial practices.

The orchard was located close to a germplasm plum orchard where about 80% of the trees were infected by the *Plum pox virus*. Furthermore, infection pressure of PPV from the surroundings was rather high according to our previous experience in the area (BLAŽEK et al. 1994).

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Table 1. Numbers of plum trees evaluated in the orchard in particular years

	1993	1994	1995	1996	1997	1998	1999	2000	Total
All plums together	515	694	1,197	1,639	1,639	1,864	1,944	2,030	
Cultivars and clones	253	431	431	591	591	813	893	975	
Seedlings	262	263	766	1,048	1,048	1,051	1,051	1,055	
Number of trees affected by plum pox	0	1	70	47	30	43	56	45	292

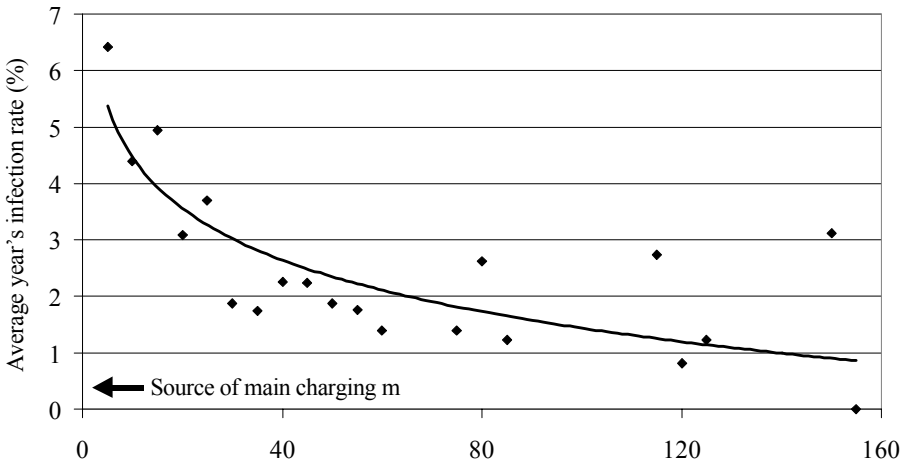

Fig. 1. Interrelations between the occurrence of plum pox and the distance (m) of the row from the neighbouring orchard affected by the disease

Every year, twice during the growing season (in June and August), all trees in the orchard were carefully inspected in search for PPV symptoms and the trees showing PPV symptoms were immediately removed by grubbing. If necessary, some doubtful cases were tested by ELISA for the final decision-making.

All affected trees by plum pox were separated into 7 categories according to their vicinity in the given or in the previous year to an area in which a charge by this disease had taken place. Numbers of evaluated and affected trees were tested by ANOVA in the following categories:

A – total of the orchard
B – occurrence of plum pox in a neighbouring tree (of the same row) in the same year
C – occurrence of plum pox in a neighbouring tree (of the same row) in the last year
D – occurrence of plum pox over one tree within the row in the same year
E – occurrence of plum pox over one tree within the row in the last year
F – occurrence of plum pox in nearby row in the same year
G – occurrence of plum pox in nearby row in the last year
H – without any occurrence of plum pox in the vicinity.

RESULTS AND DISCUSSION

The number of trees monitored in particular years, and those that were identified as infected by plum pox, are given in Table 1. In the majority of years, the share of infected trees by PPV fluctuated between 2 and 3 per cent. The extent of the infection was greatest in 1995, which was mostly due to the infection of seedlings, where the share of infection amounted to nearly 7 per cent. The explanation of this phenomenon was discussed earlier (BLAŽEK, KAREŠOVÁ 1998).

The average infection rate of trees in single rows decreased nearly exponentially with increasing distance from the adjacent orchard, which had been badly affected by plum pox and was undoubtedly the main source of infection of monitored trees (Fig. 1). This finding also fully supports our earlier results (BLAŽEK at al. 2000).

In the course of evaluation of plum pox occurrence, with trees included into different groups concerning the place of previous occurrence of this disease in their vicinity, the category B was characterized by the highest rate of infection (Fig. 2). This category expressed the risk of infection of adjoining trees in the same row within the same year if a tree was infected. In case a tree was infected, the probability of transmission of the disease to its direct neighbour was more than 3 times higher than the risk for any average tree in the orchard. Similarly, the infection of a tree significantly increased the risk for the direct neighbour in an adjoining row of trees and to the next one from the neighbour in the same row.

The above-mentioned results therefore show that the infection of a tree by plum pox, before this infection can be identified and the tree removed, contributes to the subsequent spread of the disease in the orchard. Hence it seems to be necessary to increase the frequency of tree inspections in the orchard and to accelerate the removal of affected individuals from the orchard.

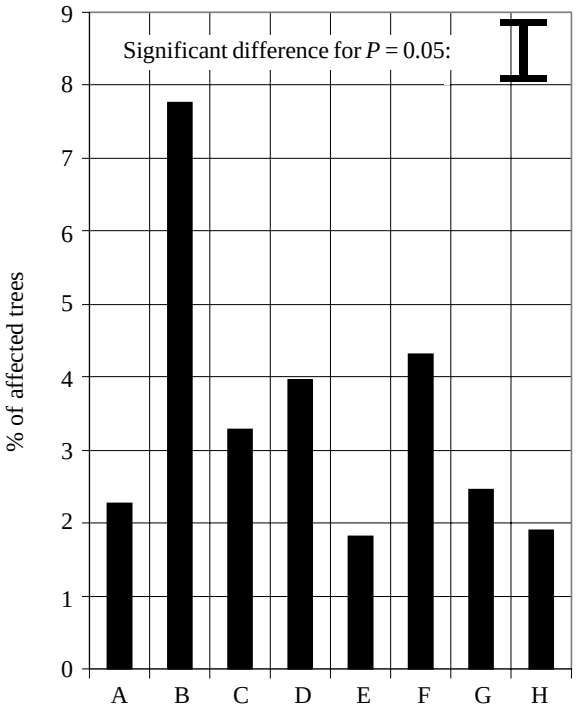

Fig. 2. Average annual occurrence of plum pox in the orchard for 1993–2000 under different conditions

Key:

A – total of the orchard

B – occurrence of plum pox in a neighbouring tree in the same year

C – occurrence of plum pox in a neighbouring tree in the last year

D – occurrence of plum pox over 1 tree within the row in the same year

E – occurrence of plum pox over 1 tree within the row in the last year

F – occurrence of plum pox in a nearby row in the same year

G – occurrence of plum pox in a nearby row in the last year

H – without occurrence of plum pox in the vicinity

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Vliv napadení stromu slivoně virem šarky na další šíření této choroby ve výsadbě

ABSTRAKT: Výskyt virové šarky po přirozené infekci byl sledován v letech 1993–2000 v pokusné výsadbě slivoní, kde byly hodnoceny odrůdy a nové hybridy. Všechny stromy, které měly symptomy této choroby, byly po zjištění těchto příznaků ihned likvidovány. Sumarizace výsledků prokázala, že napadení stromu ve výsadbě významně zvyšovalo riziko dalšího napadení sousedních stromů, přestože nemocné stromy byly ihned odstraňovány. V případě sousedních stromů v rámci téže řady se pravděpodobnost jejich napadení zvýšila přibližně trojnásobně a u stromů v sousední řadě dvojnásobně ve srovnání s průměrnou intenzitou výskytu šarky. Tato skutečnost rovněž prokazuje význam co nejrychlejší likvidace napadených stromů ihned po zjištění symptomů této virové choroby.

Klíčová slova: PPV; intenzita kontaminace; výsadba slivoní; šíření PPV

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