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SHORT NOTES

Physiological modifications caused by plum pox virus in the leaves of peach and apricot tree

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Summary. Symptomatic and asymptomatic leaves of peach (sel. IF7230685) and apricot (cv. Tyrinthos) infected by "plum pox virus" (PPV) were analysed for net photosynthesis, peroxidase activity and chlorophyl content. The presence of the PPV in the leaves excised was verified with the ELISA test. The PPV affected the photosynthetic system more strongly in peach than in apricot. Peroxidase activity (PA) and chlorophyl content were also affected. PA was a good indicator of infection, and also made it possible to distinguish different degrees of infection.

Key words: peach, apricot, plum pox virus, physiology.

Introduction

Sharka is a very serious disease that affects apricot, peach, and plum tree, and their respective grafted rootstocks; it has also been reported in sweet and sour cherry (Crescenzi *et al*., 1994; Nemchinov *et al*., 1996). The disease is caused by a potyvirus, known as the "plum pox virus" (PPV), and occurs in the Mediterranean area, in Northern and Eastern Europe (Roy and Smith, 1994), in Chile and in India (Bhardwaj *et al*. 1995). Symptoms on the leaves and fruits vary according to the susceptibility of the host plant, the virus strain and environmental conditions. PPV infected plants produce less and the fruits are deformed (Audergon, 1997). The virus is transmitted either by aphids or by grafting infected material (Jordovic, 1963; Avinent *et al.,* 1993; Labonne *et al*., 1995). There is no prevention or cure; the only way to deal with the disease is to remove and destroy infected plants.

Until now, studies have focused mainly on resistant plants. A better knowledge of the metabolic alterations induced by the virus in infected plants, which at present is very unclear, could furnish information useful for improving crop defences. The aim of this study was to investigate some of the physiological modifications that are induced by the virus in infected plants.

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Materials and methods

The study was conducted on one plant each of apricot (cv. Tyrinthos open pollinated) and peach (sel. IF 7230685 open pollinated), naturally infected with PPV. For apricot the leaves were scored in four disease classes: 0 (no visible symptoms), 1 (symptoms on up to 30% of leaf surface), 2 (symptoms on 30% to 60% of leaf surface), 3 (symptoms on more than 60% of the leaf surface). For peach the sampling distinguished only between leaves with and leaves without symptoms. Net photosynthesis (Pn) was measured in 30 leaves per cultivar with a portable Li-6002 (LI-COR, Lincoln, Nebraska, USA). Immediately after recording the Pn each leaf was excised and frozen. Half of the frozen leaves were used to measure peroxidase activity (method of Chance and Maehly, 1964) and chlorophyl content (method of Zou, 1995) in 96% ethanol. The remaining half leaves were tested by ELISA with the universal kit (AGRITEST, Valenzano, Italy) which uses Mab5B (Cambra *et al*., 1995). The data were analysed statistically with Origin (MicroCal Software, Northampton, MA, USA) and Statistica (Statsoft, Tulsa, OK, USA).

Results and discussion

Table 1 shows that the content of photosynthetic pigments was always higher in peach than in apricot, irrespective of the disease score. Following viral infection, there was a reduction of both chlorophyl a and b, in apricot and especially in peach, but in peach the ratio between the two chlorophyls was lower than in apricot. Since a high ratio between chlorophyls signifies a high photosynthetic potential, the photosynthetic potential of peach is lower than that of apricot, even though it is not influenced by infection. PPV (the presence of which in symptomatic leaves was shown by the ELISA test) had an important effect on photosynthetic activity: in apricot and peach leaves showing symptoms, the Pn was reduced by approximately 29%, and 40% respectively. At the same time, there was an increase in stomatic resistance that was much stronger in infected apricot than peach; as a consequence transpiration was strongly reduced in apricot leaves, while it did not change significantly in peach (Fig. 1). It is known that Pn goes down in situations of stress when the plant tends to restore water losses (Raschke, 1979), for which the ratio (A/E) between the net influx of CO_2 (A) and efflux of water vapour (E) turns out to be altered: it increases in infected apricot leaves (from 1134 to 1812), and decreases in infected peach leaves (from 2060 to 1437). The relationship between Pn, transpiration and stress caused by infection was especially evident when there were different severities of infection, as with apricot (Fig. 1), for which a very good linear correlation (R = 0.94) between A/E and symptom severity was found.

With peach and apricot leaves, as also with other plant species (Visedo *et al*., 1991), peroxidase activity increased with symptom severity (Fig. 2). This was especially evident in apricot, in which the K´´ value (enzyme dissociation constant) went from 0.0027 to 0.145. Peroxidase activity in healthy peach leaves was greater than that in healthy apricot leaves, which made the observed increase in infected leaves of apricot even greater. It is inter-

Table 1. Content of photosynthetic pigments in apricot and peach leaves infected with plum pox virus.

Photosynthetic pigment	Apricot				Peach	
	Class of symptoms				No symptom	Symptoms
	0	1	2	3		
Chlorophyl a	0.57[a] ± 0.03	0.46 ± 0.01	0.42 ± 0.02	0.42 ± 0.02	2.04 ± 0.03	1.43 ± 0.09
Chlorophyl b	0.12 ± 0.01	0.11 ± 0.01	0.10 ± 0.00	0.10 ± 0.00	0.65 ± 0.02	0.47 ± 0.04
Total a+b	0.62 ± 0.03	0.57 ± 0.06	0.52 ± 0.02	0.52 ± 0.02	2.69 ± 0.06	1.90 ± 0.12
Ratio a/b	4.75 ± 0.03	4.18 ± 0.18	4.20 ± 0.17	4.20 ± 0.17	3.13 ± 0.06	3.04 ± 0.12

[a] Mean ± SE.

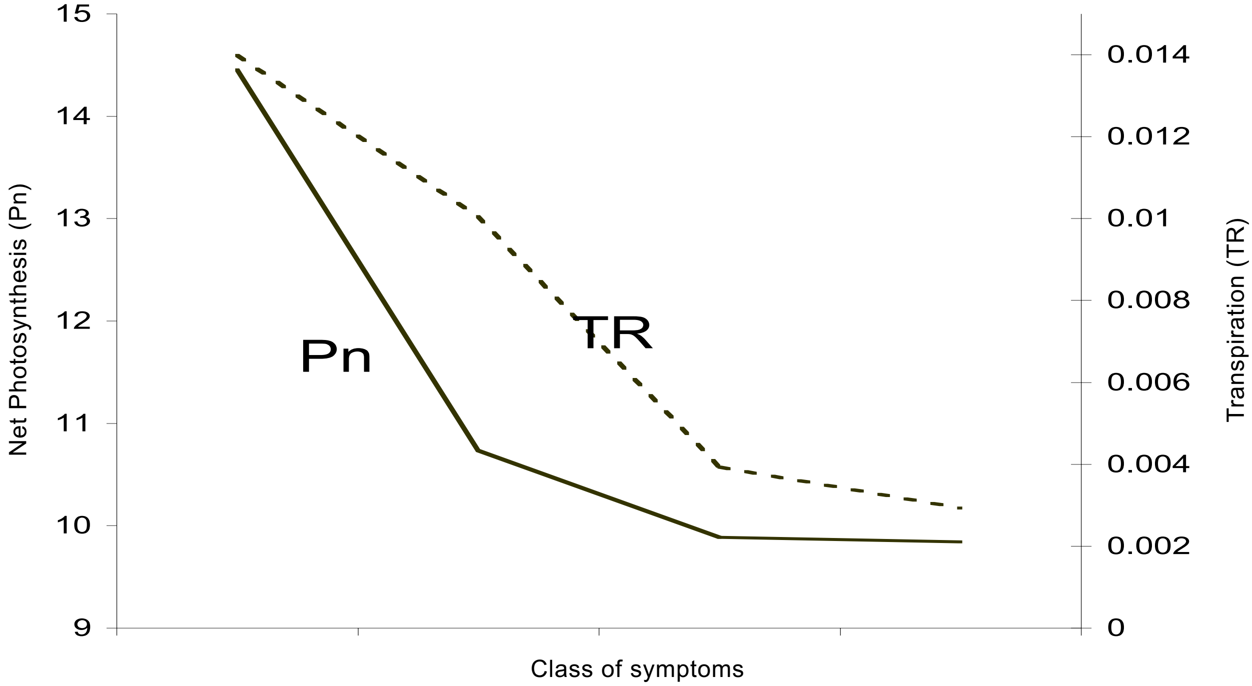

Fig. 1. Reduction of net photosynthesis (Pn) and transpiration in apricot leaves according to different symptom classes : 0=no symptoms, 1=10%, 2=40%, 3=70%.

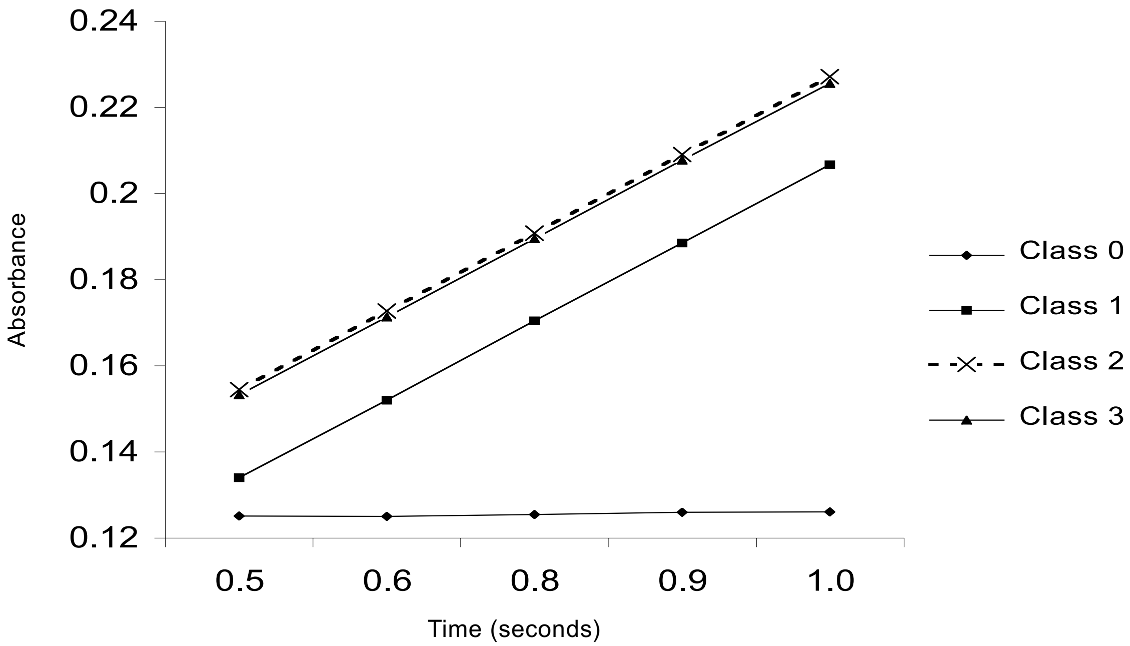

Fig. 2. Peroxidase activity expressed as absorbance in leaves of apricot with no symptom and with different symptom class (0 to 3).

esting that peroxidase activity if measured quickly, enabled different levels of infection to be distiguished (Fig. 2): in apricot variations of absorption were lowest in class 0 leaves, higher in class 1 leaves, and considerably higher in leaves with class 2 and 3 symptoms, though these last did not differ between themselves.

It is concluded that peach and apricot showed a physiological reaction to infection that was similar but differed in degree: in peach there was greater damage to the photosynthetic system (a lower ratio between the two chlorophyls and a greater reduction in overall photosynthesis) which did not correspond to an adequate block of water losses. The level of peroxidase activity, which increased greatly in the presence of the virus, was a good indicator of infection and distinguished different degrees of infection.

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