Damage to peach and apricot trees in selected localities of Slovakia

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ABSTRACT: In this paper we have evaluated the health condition of *Prunus persica* (L.) Batsch and *Prunus armeniaca* L. for the occurrence of the parasitic microscopic fungus *Cytospora cincta* Sacc. Apricot trees in 5 localities with 10 sites and peach trees in 5 localities with 8 sites were evaluated. We identified symptoms of the disease in host plants, conditions for isolation and cultivation of the fungus and the growth rate of the mycelium hyphae on various substrates. The damage degree was evaluated in 330 trees in four localities while most trees were characterised by degree 1–3. We have derived conclusions for protective measures to prevent further spreading of the infection.

Keywords: *Prunus persica*; *Prunus armeniaca*; *Cytospora cincta*; health condition; plant protection

Among the most common diseases of stone fruit trees, primarily apricots (*Prunus armeniaca* L.) and peaches (*Prunus persica* [L.] Batsch), it is recognised instantaneous or gradual drying of twigs and branches resulting in premature dying of relevant trees. The drying itself, occurring in spring or summer, is sometimes preceded by the formation of necrotic bands, cracks, cavities, discolorations and tumours connected with resin in the case of unfavourable soil or nutrient conditions (Čača 1991; Vaník, Hlaváč 1999). A more frequent cause initiating the disease is frost and mechanical damage facilitating the spreading of infection caused by the fungus *Cytospora cincta* Sacc. or by the bacterium *Pseudomonas syringae* van Hall. The attacked spots are gradually dying down. In the case of total breaking off conductive pathways, there occurs immediate leaf wilting and dieback of whole branches and finally of the whole tree (Stanová 1970; Iezzoni et al. 1990; Milles et al. 1990).

Apricot tree, *Prunus armeniaca* L., a fruit species originating from East Asia, has not been adapted sufficiently to the climate conditions in Central Europe. In Slovakia the species is well known by a very long vegetation period. In autumn, the tree leaves cannot reach their appropriate maturity stage, they are prematurely damaged by early frosts, and, consequently, their resistance to harsh winter frosts is lowered substantially. The average age of apricot orchards is commonly 20 to 25 years; there are, however, individual trees reaching 80–100 years in full fertility, in spite of the fact that the fruit size is small. This is the case of the well known cultivars Maďarská or Veľkopavlovická.

Peach tree, *Prunus persica* (L.) Batsch, is native to China; in Slovakia it was already distributed in the 16th century. The tree prospers in southern lowland areas up to 200 m a.s.l., with the mean annual temperature of 9–10°C, or on steep lands in higher and northerly situated areas with the mean annual temperature of about 8°C, but not in locations where the temperature during night falls below the freezing point (frost pools).

MATERIAL AND METHODS

In the paper we evaluated the health condition of apricot trees in 5 localities with 10 sites. Peach trees were evaluated in 5 localities with 8 sites.

Table 1 presents a list of the evaluated localities and cultivars of apricot and peach trees in Slovakia. The localities in the region of Nitra belong to the Podunajská lowland. The northern boundary of the territory consists of the Tríbeč Mts. and the Nitra

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Table 1. Localities and cultivars of apricot and peach trees

Locality	Site	Apricot[1], Peach[2]/Cultivar name	Age
Nitra-Kynek	Gardening settlement	[1]Maďarská	40
		[2]Redhaven, Fairhaven, Elberta	3–25
Nitra-Zobor	Moskovská st.	[1]Maďarská	50
		[2]Redhaven, Elberta	5–20
	Kodályová st.	[1]Maďarská, Veľkopavlovická	45
		[2]Redhaven	20–25
	Tatarkova st.	[1]Weecot	25
		[2]Lednická yellow, Redhaven	10–25
Nitra-Drážovce	Vineyard	[1]Maďarská	45
		[2]Redhaven, Lednická yellow	10–25
Nitra SAU orchard	Botanical garden	[1]Veľkopavlovická, Karola, Vegama, Vesna, Maďarská	35
Nitra SAU orchard	Botanical garden	[2]Redhaven	3–25
Modrý Kameň	Private garden	[1]Maďarská	40
		[2]Redhaven	20–25
Poproč	Private garden	[1]Veľkopavlovická, Maďarská, Sabinovská	45
		[2]Redhaven, Fairhaven	20
Jasov	Private garden	[1]Veľkopavlovická, Maďarská	30–40
		[2]Redhaven	20–25
Vráble	Bodog Company	[1]Veľkopavlovická, Maďarská	35–40

River. Mean annual precipitation total is 539 mm, mean annual temperature in the vegetation period is 15°C, mean annual temperature is 9.8°C. Dominant soil types are typical Fluxions, pseudogley saturated Cambisols and Rendzinas. The age of apricots ranged from 25 to 50 years, the age of peach trees from 3 to 25 years.

Localities in the surroundings of Jasov and Poproč are situated in the Košická basin either in the valley of the Bodva River at altitudes to 255 m a.s.l. or on southern foothills of the Volovské hills to 365 m a.s.l. Mean annual precipitation total is 539–600 mm, mean annual temperature of air in the vegetation period is 15°C, mean annual temperature is 8.5°C. Dominant soil types are Cambisols, carbonaceous pseudogley Fluvisols, typical Fluvisols, pseudogley Cambisols and Rendzinas. Apricot trees were at the age from 30 to 45 years, peach trees from 20 to 25 years.

The isolation and cultivation of pathogens were performed with attacked bark of stem and branches sampled from transition zones, in necrotised parts or spots with foci of *Cytospora cincta* visible to the naked eye. The samples were sterilised, washed in distilled water (10 min) and cultivated on agar substrates (3% potato and 3% maltose). The cultivation was accomplished in dark conditions, at a temperature of 24–25°C. After 2–3 days the mycelium was cultivated with the aim to obtain a pure culture.

The basic method to evaluate the health condition of examined stone fruit trees was the inventory of occurrence and distribution of parasitic microscopic fungi causing drying of branches and damage to tree stems. In orchards we evaluated 3 × 30 trees, in private gardens the number of the evaluated trees followed the number of trees growing in the relevant locality. The health condition of apricot and peach trees was evaluated between 2002 and 2004 (from January to December). The damage degree (1–5) was classified according to the method elaborated by Juhásová (1999). The examined trees were ranked to 6 categories according to the degree of crown damage and the number of canker wounds:

Degree 0 – trees are healthy, no symptoms of disease;

Degree I – concaves appearing on branches and/or stump sprouts, leaves turning yellow;

Degree II – brown dry leaves on branches and/or stump sprouts. Marked colour changes appearing on smooth bark of the stem and smooth branches at the spot of infection;

Degree III – dry, brown leaves on branches and/or stump sprouts. At the spot of infection, longitudinal bark cracks appearing on the stem and on branches. On older trees rough bark cracks and canker wounds are formed mainly on the stem and stump sprouts;

Table 2. Results of evaluation of the degree of damage to apricot and peach trees in selected localities in Slovakia

Locality	Tree	Degree of damage/number of trees					
		1	2	3	4	5	Sum
SAU Nitra – Botanical garden	apricot	13	4	9	2	2	30
		6	16	2	6	0	30
		8	12	9	1	0	30
Bodog	apricot	0	6	16	7	1	30
		0	11	9	4	6	30
		1	10	17	1	1	30
Poproč	apricot	7	9	13	1	0	30
Jasov	apricot	14	6	9	1	0	30
SAU Nitra – Botanical garden	peach	11	5	9	4	1	30
		5	5	17	3	0	30
		2	13	14	1	0	30

Degree IV – more than 2/3 of dry branches in the crown of the tree. The bark peels in longitudinal strips on the stem as well as on branches;

Degree V – the whole crown of the tree is dry, marked canker wounds appearing on the stem and on branches.

Parasitic microscopic fungi were detected in a laboratory according to Bánhegyi (1985) and Brandenburger (1985). The cultivars of apricot and peach trees were determined according to Kyncl (1980), Čejka et al. (1982) and Hričovský (2000).

RESULTS AND DISCUSSION

The spores of *Cytospora cincta* (imperfect stage of the ascomycete *Leucostoma cincta* Fr. [Höhn]) penetrate the living tissue of bark only if this environment also contains dead cells of the host woody plant. These dead cells provide conditions for growth and further rapid penetration into the healthy tissues of the host. In most cases, the infection begins in the dormancy period (November–February). The dead parts of the bark become to be spotted with warty brown-black fruiting bodies of the fungus, penetrating from the cambium. Acute apexes of the fruiting bodies cut across the bark. The apexes of mature fruiting bodies start to gap and release thin, long filaments of glued pinkish spores, forming bands in contact with air. The leaves above the attacked spot begin to fade, remain small, the branches gradually die. The bark is gradually getting brown-red. The attack of xylem is manifested with longitudinal brown colouring. In wet weather conditions, the openings of pycnids release considerable amounts of imperfect stages – conidia in the shape of thread-like, spiral-formed bodies. The conidia are produced on carriers (1.2 × 1.8 μm in size), they are vitreous, horn-curved, and their size in apricot trees is 5.5 × 1.5 μm, in peach trees 6.1 × 1.5 μm. Statistical differences between the morphological characteristics are significant in length (*F*-ratio 66.354, sig. level 0.0000**), but they are not significant in width (*F*-ratio 0.266, sig. level 0.6180, Table 3) although we can suppose that the same pathogen (*C. cincta*) is parasitic on both woody plants. The imperfect stages are further spread by rain, dew, wind, by insects, birds and also with working tools. The infection enters the tree via bark injuries of various origin (frost, hail, insects, bark disease, work tools, pruning in the period of dormancy, and also leaf scars). In the case of xylem exposure, the course of infection is accelerated. The stroma of the fungus is irregular, warty, frequently scattered over whole branches. The stroma with pycnids can be present in living and dead wood; however, foci with perithecia were found only in dry wood – which is in accordance with Urban (1956) and Stanová (1972). Asci are 50–70 × 8–16 μm in size. Ascospores are ellipsoid-shaped, with dimensions of 7–20 × 3–6 μm. The damage symptoms on the evaluated trees correspond to the symptoms of damage to these woody plants described by several Slovak and foreign authors (Szécsi et al. 1985; Stanová 1970; Milles, Biggs 1989; Pedryc, Rozsnyai 1991; Molnár 2002).

Table 3. Comparison of averages according to the results of Analysis of variance

Species	Length by species	Width by species
	Stnd. error average	Stnd. error average
Prunus amygdalis	5.4200000a	1.4100000a
Prunus persica	5.9500000b	1.3800000a

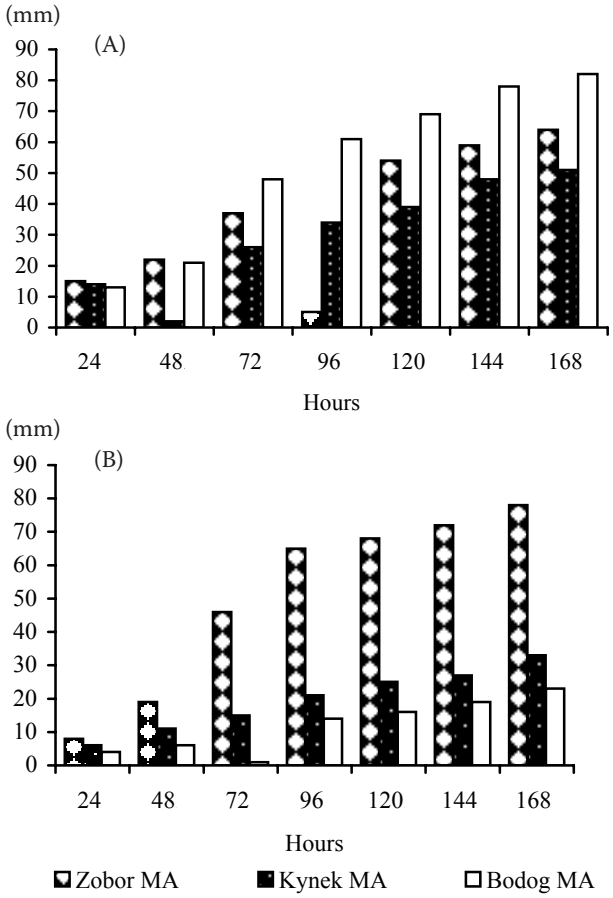

Fig. 1. Growth rates of mycelium hyphae of the fungus *Cytospora cincta* Sacc. isolated from apricot in selected localities in Slovakia – medium PDA and MA

The first symptom of the tree response to infection is gum production, later followed by discolorations and cavities in the bark. Phloem and cambium tissues as well as xylem are necrotised. In the case of autumn infections, the course is very rapid; connected necrotic girdles around the whole branch periphery are very common. Such a branch either cannot sprout in the spring any more or the sprouted leaves will immediately dry. In the midst of the vegetation period (May, June), the progressive stage of the disease is manifested through an instantaneous severe wilting of leaves which already prematurely yellowed and were shed in the preceding autumn. The attacked branches dry, turn fragile, easy to break and later they are covered with pycnidia. In the course of one vegetation period, the attacked tree can totally die, which is evident on an abrupt leaf wilting.

The isolation of the fungus *C. cincta* was successful on all the used substrates (3% potato PDA and 3% maltose agar MA). After 3–4 days of cultivation of the infected material, the mycelium of the fungus appeared. The growth increment of the mycelium hyphae of the fungus *C. cincta* on isolates from apricot trees ranged from 13 to 82 mm in 168 hours on the 3% potato agar, and from 4 to 78 mm in 168 hours on the 3% malt agar. The growth rate of the mycelium hyphae on the isolates from peach trees was lower – within 192 hours. The increment was from 6 to 64 mm on the 3% potato agar and from 6 to 56 mm on 3% malt agar (Figs. 1A,B; 2A,B). The growth rate on various media was not regular, after 24 hours the growth rate was significantly higher on PDA medium. No significant difference in the effect of the medium on the growth rate of mycelium hyphae was recorded after 48 hours. The differences were equalised. The growth rate was on average higher for apricot trees, but not significantly. The higher growth rate was achieved on average of the experiment in the locality Zobor, but the difference was not significant, either (Table 4).

The main source of infection is in leaves left on the trees even for several years, which is a frequent practice in abandoned and unmanaged apricot and peach orchards. The bark and wood necrosis persists to the following years, in many cases it attacks lower branches without external symptoms. Sometimes

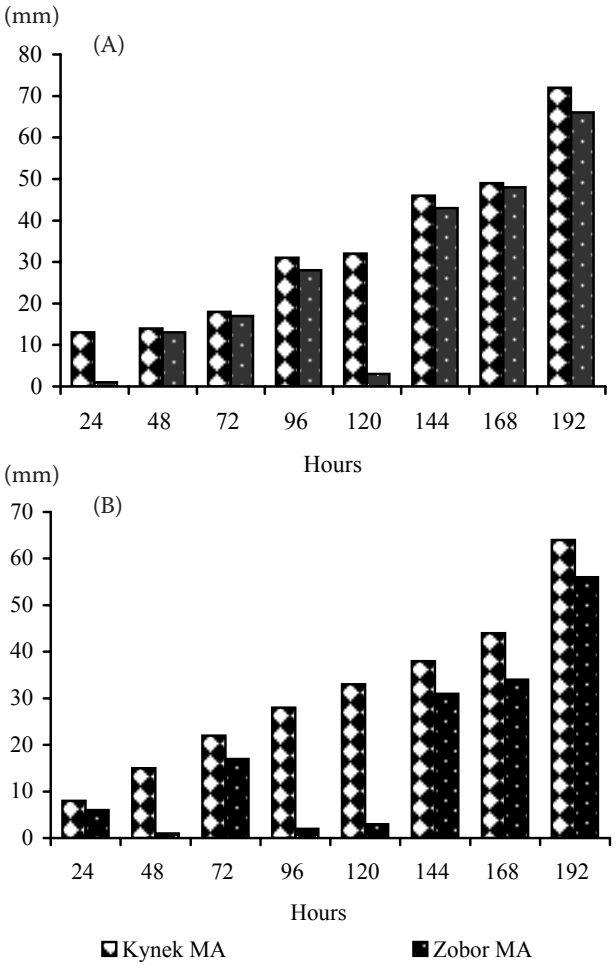

Fig. 2. Growth rates of mycelium hyphae of the fungus *Cytospora cincta* Sacc. isolated from peach in selected localities in Slovakia – medium PDA and MA

Table 4. Results of Analysis of variance (*F*-ratio)

Hours		Species	Locality	Culture medium
24	*F*-ratio	2.4730	4.0520	59.8350
	Sig. level	0.1767	0.0899	0.0006**
48	*F*-ratio	3.1090	1.8350	5.2300
	Sig. level	0.1381	0.2526	0.0709
72	*F*-ratio	2.7340	1.0060	0.0190
	Sig. level	0.1591	0.4295	0.8970
96	*F*-ratio	2.3230	1.2450	0.8380
	Sig. level	0.1880	0.3641	0.4114
120	*F*-ratio	1.3830	0.7690	0.8040
	Sig. level	0.2925	0.5114	0.4201
144	*F*-ratio	0.8690	0.8400	2.2840
	Sig. level	0.4035	0.4849	0.1911
168	*F*-ratio	0.9480	0.8990	1.9610
	Sig. level	0.3848	0.4640	0.2203

the attacked tree seeks for the wound recovery and, in such a way, for the necrosis localisation, by an intensive formation of healthy tissue and callus around the necrotic wound. The callus tissue is infected with the pathogen again, which results in the canker-pattern of necroses accompanied in the case of peach trees by excessive gummosis and formation of epicormic shoots. The cytospore-induced drying is characteristic of the disease persisting from year to year. With the increasing age, the number of wounds, necroses and tumours increases, and the diseases acquires an accumulative character and we can classify it as a permanent progressive cancer (Matlák 1998; Molnár 2002). The disease is spread focus-like in the stands.

Table 2 presents the results of evaluation of damage to apricot and peach trees caused by the fungus *C. cincta* Sacc. in selected localities in Slovakia. The degree of damage was evaluated in 330 trees in four localities. Tree species growing in the examined localities are of relatively high age (apricot from 25 to 50 years, peach from 3 to 25 years) when he number of wounds and necrosis increases; most trees were damaged to degree 1–3 but there exist trees damaged to degree 4 and 5.

Protection against this type of drying is difficult because the mycelium of the fungus penetrates from the phloem to the xylem part. In such a case, the damaged branch cannot be saved. The protection must be based on prevention, which means to provide optimum conditions for safe and healthy growth and development of woody plants – beginning with the choice of appropriate sites and cultivars, through harmonically equilibrated nutrition, limiting conditions for the occurrence and distribution of diseases by timing the pruning to the beginning of sprouting, up to removing necroses and tumours, dry branches and whole dead trees.

Treatment with fungicides performed in autumn is prevention against infections on scars and other injured spots. However, it is not possible to influence infection processes already in progress. The most appropriate fungicides are Kuprikol 50 or Kuprofor 50 SC, Kuprotix 20 DKW, Champion 50 WP, Sulka and Polybarit. Biological protection is based on the antagonism between the fungi *Trichoderma koningii, Fusarium lateritium* (*Gibberella baccata*), *Coniothyrium* sp. and several strains of bacteria inhibiting fungi of the genus *Cytospora* (Rozsnyai et al. 1995).

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Poškodenie kôstkovín (marhúľ a broskýň) na vybraných lokalitách Slovenska

ABSTRAKT: V práci sme hodnotili zdravotný stav kôstkovín *Prunus persica* (L.) Batsch a *Prunus armeniaca* L. na piatich lokalitách Slovenska z hľadiska výskytu parazitickej mikroskopickej huby *Cytospora cincta* Sacc. Marhule boli hodnotené na piatich lokalitách a z nich na desiatich stanovištiach, broskyne tiež na piatich lokalitách a z nich na ôsmich stanovištiach. Stanovili sme symptómy ochorenia hostiteľských drevín, podmienky izolácie a kultivácie huby ako aj rýchlosť rastu hýf jej mycélia na rôznych živných médiách. Stupeň poškodenia sme hodnotili na 330 stromoch na štyroch lokalitách; stupeň poškodenia bol rozdielny. Najviac stromov bolo poškodených stupňom 1–3. Záverom sme navrhli ochranné opatrenia na zamedzenie ďalšieho rozširovania infekcie.

Kľúčové slová: *Prunus persica*; *Prunus armeniaca*; *Cytospora cincta*; zdravotný stav; podmienky ochrany

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