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Possibilities of blossom and twig blight management in organic stone fruit production

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Summary: In this study, possibilities of environmentally-benign plant protection against blossom and twig blight were summarized for organic stone fruit orchards. Symtomps of *Monilinia laxa* (Aderh. & Ruhl.) Honey) were described and then cultivar susceptibility to blossom and twig blight was discussed. Several sustainable plant protection methods were selected and discussed in details such as mechanical, agrotechnical, biological, and other non-chemical control possibilities (stone powders, plant extracts and restricted chemical materials).

Key words: blossom and twig blight, organic production, stone fruits, *Monilinia* spp.

Introduction

Two old brown rot species can be distinguished in Hungary which are considered to cause the major damage of stone fruit species. One is *Monilinia fructigena* (Aderh. & Ruhl.) Honey, and the other is European brown rot (*Monilinia laxa* (Aderh. & Ruhl.) Honey). The third member of the old brown rot family (*Monilinia fructicola*) is not discussed here. More details about the environmentally-benign control of *M. fructicola* can be found in a previous review of *Holb* (2003, 2004, 2006).

European brown rot is one of the most dangerous diseases of stone fruits (primarily of sour cherry, sweet cherry and apricot) causing the death of shoots and younger branches. At blooming and fruit set, the shoots begin to wilt and then they suddenly become dry. The dry leaves do not fall down, they stay on the tree during the whole season. A strong infection might also cause the death of woody shoots and older branches. Since the pathogen is a wound parasite, it appears on the fruits at injuries after hail or strong pest damage. Brown rotting of fruits starts and then grey conidiophores appears on their surface. The fruits often mummify and stay on the tree. The primary inoculum sources of the disease are the dead woody parts and the fruit mummies. The disease can also cause significant damages during storage. Its host plants include the stone fruit species *Holb* (2003, 2004, 2006).

In this study cultivar susceptility and sustainable plant protection methods against blossom and twig blight were discussed such as mechanical, agrotechnical, biological, and other non-chemical control possibilities.

Cultivars susceptibility

Susceptibility of fruit species and cultivars to brown rot fungi under East-European climate conditions was discussed by *Soltész* (1997), therefore, only some examples are mentioned here (*Table 1*).

In the case of sour cherry, blossom and twig blights are the most important symptoms of brown rot decay (*Paszernák* et al., 1982). There are some sour cherry cultivars which have a low susceptibility or disease tolerance, such as 'Nagy Angol', 'Mocanesti', 'Oblacsinszkaja', 'Cigánymeggy 3', 'Maraska Savena', 'Mettar' and 'Elegija' (*Soltész*, 1997).

Table 1 Examples of resistant and susceptible fruit cultivars to blossom and twig blight caused by *Monilinia* spp.

Fruit	Host resistance	Plant organ	Cultivar	Reference
apricot	tolerant	blossom, twig	Neptun, Mamaia, Silvana, Sulina, Sirena	*Cociu* cit. *Soltész*, 1997
apricot	high susceptibility	blossom, twig	Budapest, Mandulakajszi	*Szabó,* 1997
apricot	moderate susceptibility	blossom, twig	Ceglédi óriás, Liget óriás, Polonais	*Szabó,* 1997
apricot	low susceptibility	blossom, twig	Borsi-féle kései rózsa, Piroska, Pannónia, Ceglédi bíborkajszi, Magyar kajszi, Rakovszky	*Szabó,* 1997
sour cherry	partial resistance	blossom, twig	Csengődi, Akasztói, Cigánymeggy 59	*Apostol,* 1990; *Apostol & Véghelyi,* 1992
sour cherry	low susceptibility	blossom, twig	Lativiszkaja Nizkaja, Nagy Angol, Mocanesti, Ljubszkaja, Sirpotreb, Oblacsinszkaja, Cigánymeggy 3, Maraska Savena, Mettar, Elegija	*Soltész,* 1997

Moreover, *Apostol* (1990) and *Apostol & Véghelyi* (1992) revealed that cvs. 'Akasztói' and 'Cigánymeggy 59' were partly resistant to *M. laxa.* Sour cherry cultivars of Pándy type are very susceptible to fruit rot (*Paszternák* et al., 1982). In the domestic cultivar assortment, the Pipacs cultivars (Korai pipacsmeggy, Pipacs 1) show a certain level of resistance. It has been known that cv. 'Csengődi' is highly, though not absolutely resistant brown rot, therefore it is highly recommended for organic production (*Apostol,* 1990, *Apostol & Véghelyi,* 1992).

In the case of apricot blossom blight caused by *M. laxa* can be significant diseases. Susceptibility of cultivars is high if they are late blooming. In Romania, several apricot cultivars tolerant to brown rot were bred such as 'Neptun', 'Mamaia', 'Silvana', 'Sulina' and 'Sirena' (*Cociu* cit. *Soltész*, 1997). *Szabó* (1997) classified several apricot cultivars into brown rot susceptibility groups. He evaluated cvs. 'Budapest' and 'Mandulakajszi' as highly, 'Ceglédi óriás', 'Liget óriás' and 'Polonais' as moderately and 'Borsi-féle kései rózsa', 'Piroska', 'Pannónia', 'Ceglédi bíborkajszi', 'Magyar kajszi' and 'Rakovszky' as lowly susceptible to blossom and twig blights caused by *M. laxa*.

Mechanical and agrotechnical control

One of the most important control elements against European brown rot is the removal of primary inoculum sources. The mummified fruits should be regularly collected from the tree and from the ground. The blighted twigs and mummified fruits should be removed and destroyed during winter pruning. The mummies should be ploughed into the soil, so that they are destroyed as a result of the soil microbiological processes. Under foggy, humid weather conditions, severe blossom blight occurs. The damage is further increased if the canopy is dense. Therefore, we should aim to reach a less dense canopy, thereby we can significantly reduce the conditions favourable for infection (*Holb,* 2005).

Biological control

Biological control against European brown rot dates back to the 1960s. *Jenkins* (1968) found that some bacteria dissolve and destroy the hyphae of *Monilinia* species. Later, it has been proved that these bacteria also produce a significant amount of antibiotics. After the successful identification of the bacteria (*Bacillus cereus* and *B. substilis*), they have been successfully applied to prevent the fruit rot of stone fruits during storage (*Pusey & Wilson*, 1984). Since the end of the 1980s, Melgarejo and her research group has performed extended research in the field of biological control against *M. laxa* (*Table 2*). They have identified several antagonist species such as *Penicillium frequentans* (*Melgarejo* et al., 1989), *Penicillim purpurogenum* (*Larena & Melgarejo*, 1996), and *Epicoccum nigrum* (*Madrigal* et al., 1991). Among the three species, *P. frequentans* and *E. nigrum* seem promising as regards their application in the practice. *Larena* et al. (2003) have produced a stabil bioproduct of *E. nigrum* in laboratory.

Table 2. Some organisms used in biological control against *Monilia* spp.

Target organism	Bioprotection agent
M. laxa, M. fructigena	*Trichoderma viridae*
M. laxa	*Aspergillus flavus*, *Epicoccum nigrum*, *Penicillium chrysogenum*, *P. frequentans*, *P. purpurogenum*
M. laxa	*Penicillium frequentans*
M. laxa	*Penicillium frequentans*
M. laxa	*Epicoccum nigrum*
M. laxa	*Epicoccum nigrum*
M. laxa	*Metschnikowia pulcherrima* (yeast)

Approved chemical materials

Three chemical compounds are permitted in Hungarian organic plant protection: elemental sulphur, lime sulphur and copper compounds (*Holb & Veisz*, 2005). Sulphur was the first pesticide used against brown rot diseases. Sulphur was applied in some regions in every 7 or 14 days from blossom until fruit maturity. These control measures were responsible for a substantial reduction in fruit losses, although the results were not satisfactory. Therefore, *Rudolph* (1925) developed a protective spray schedule that has proved relatively effective on apricots. The trees were sprayed with Bordeaux mixtures when the blossoms were at pink bud stage. Where the disease has been severe, two sprays were advised, one at tight cluster stage and one at full bloom. These sprays were phytotoxic to floral parts of the trees. In Hungary, in the early 1920's, *Béla Husz* proved the fungicide activity of Bordeaux mixture against *M. laxa* during bloom (*Berend*, 1957) and his recommendations were used until World War II. In the 1950's, liquid lime sulphur applications were suggested against blossom blight (*Ogawa* et al., 1954). However, authors noted that lime sulphur applications on blossoms may result in severe flower damage. Eradication of incipient fruit infection on cling peaches following rains during the last three weeks before harvest was shown to be possible with ground application of liquid lime-sulfur within 37 hours from the beginning of rain (*Ogawa* et al., 1954). Recently, *Holb & Schnabel* (2005) developed a lime sulphur and a wettable sulphur spray schedule against brown rot blossom blight of sour cherry for organic sour cherry production. Nowadays, copper-containing fungicides are the most frequently used chemicals against the disease in organic production. Control should be started already before bud burst with a high-volume spray. Critical periods are blooming and ripening. It has been known that a 0.2% copper-hydroxide hidroxid (e.g. Cuproxat FW) applied at tight cluster stage in sour cherry and apricot can significantly reduce the risk of brown rot infection. During blooming, the plants are highly sensitive to copper. Special attention should be paid to peach, since copper can cause severe phytotoxicity in it already at the green tip stage.

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