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# Control of *Marssonina* leaf fall disease in organic apple production

## Info

### History

The disease has been mentioned in the literature in many areas for quite some time (1971), but only as a minor problem. The first severe attacks were reported from southeast Asia on apple in 1995. *Marssonina* was first found in Europe in Italy in 2001. Between 2009 and 2015 the disease spread out over all apple production areas in the alpine region: Northern Italy, Switzerland, Southern Germany and Austria. In 2014 the disease was found in cider orchards in Brittany (France).

***Marssonina coronaria* is a new very aggressive leaf fall disease on apple. Where it hits, complete orchards are defoliated before harvest. In the past five years, the disease spread over the alpine regions and to Brittany. The application of lime sulphur is the most practical way to control *Marssonina* together with other summer diseases in organic apple orchards. A first version of an infection model for the timing of these fungicide applications is available on the RIMpro Cloud platform.**

At first it was thought of as a disease only occurring on untreated apple trees in the landscape, and in scab resistant orchards receiving a minimal fungicide program. Meanwhile, the management of *Marssonina* in organic apple orchards in the affected production regions has proven difficult, requiring an intense fungicide program during summer. In IPM orchards, *Marssonina* is likely suppressed by the regular fungicide program. However, as soon as this program is lifted at the end of summer, the disease develops. During autumn 2015, symptoms of *Marssonina* could be found in many IPM orchards in South Tirol and Austria. In the first years of its occurrence, Vf-scab resistant apple cultivars were regarded as very susceptible for *Marssonina*. Now we understand that the severe outbreaks on these cultivars are mainly a result of the low fungicide input. Most commercial apple varieties are moderately to highly susceptible to this disease. Only Golden Delicious and Pinova seem to be less susceptible. So far, the only cultivar found immune to this disease is an old local Austrian cultivar: Kronprinz Rudolf.

### How it starts

Asian literature claims that first infections in spring are caused by ascospores produced in leaf litter on the orchard floor just like apple scab. But so far no one was able to catch any ascospores in Europe. The first symptoms which occur end

of June- early July seem to appear in the same parts of orchards every year. But not necessarily on the same tree, which was confirmed by observations on marked trees in 2014 and 2015. In 2015, this mystery was solved: In two orchards we found the first symptoms in the first tree of the rows every year. We saw this as an indication that the disease originates from outside the orchard, and blamed untreated high stem apple trees in the surroundings. In 2015 however the first trees in the orchards showed the first symptoms earlier than the untreated high stem trees. Above all infected trees, we found old leaves stuck in the hailnet (Figure 1). Where there were no leaves in the hailnet there was no *Marssonina*. So *Marssonina* can survive in old leaves trapped in hailnets and start the epidemic from there.

### Control

Fungicide programs consisting of sulphur, bicarbonate and low rates of copper have proven to provide insufficient control of *Marssonina* under practical conditions. As our aim should be to reduce the copper input in organic agriculture, frequent applications of copper fungicides during summer can't be the future strategy for the control of *Marssonina*. Acidified clay powders (Myco-Sin®, Ulmasud®) have shown reasonable control under trial conditions. However the use of these products complicates the control of other summer diseases that infect at the same time



In June 2015 first symptoms were found under old leaves that had overwintered in the hail net.

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such as apple scab and sooty blotch which are not sufficiently controlled by acidified clay powders. It is not even clear if these products will be allowed for use as fungicide in Europe in future. In this perspective the practical control strategy for *Marssonina* in organic apple production is the well-timed application of lime sulphur. The longer wetness periods at higher temperatures that allow for *Marssonina* infections, also allow infections by other summer disease as apple scab and sooty blotch. Lime sulphur will control all tree summer diseases.

## Knowing when to treat

We use models to help decide when applications are necessary to control apple scab, but until now no model for *Marssonina* infections existed. The high economic risks of *Marssonina* strikes, and the lack on any information on infection moments, lead to very intense fungicide schedules in organic orchards.

Basic information on infection conditions for *Marssonina* are known, but details on the infection biology are unclear. All available information from published and unpublished sources was used to construct a first version of an infection model. The reasoning in the model is as follows:

1. The model starts with an inoculum of spores produced in overwintering leaves. This inoculum decreases during spring.

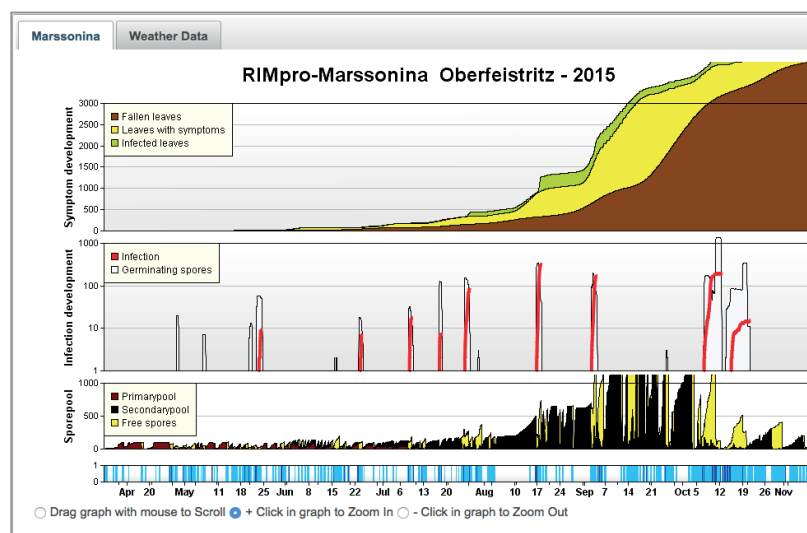
2. Spores from this primary source are splash distributed to the new leaves.
3. Germination of *Marssonina* spores requires higher temperatures than apple scab. Although first spores can infect after 8 hours of wetness, important infections need 20 to 50 hours of leaf wetness.
4. The incubation time is depending on temperature. Below 15 °C it can take more than 5 weeks before symptoms begging to appear. Over 20 °C the incubation time is 2-3 weeks.
5. On infected leaves small round black structures (=acervuli) are visible in which new spores are formed.
6. For apple scab, the spores are produced directly on the leaf surface and can be distributed by raindrops immediately. The acervuli of *Marssonina* need longer wetness periods for spore maturation and liberation. The longer the leaves stay wet, and the longer raindrops are splashing on the leaves, the more spores are distributed. Severe infections need more than 15 mm of rain.
7. For apple scab only the young leaves are susceptible. For *Marssonina* all leaves are equally susceptible. With the increase of the epidemic in summer, eventually all leaves get infected, turn yellow, and drop.

## Validation of the model

In 2015 we started field observations to validate the model under different climatic conditions: in France, Italy, Switzerland, Germany and Austria. The first impression is that the model explains the observed epidemics reasonably well. Despite it's limits, the model can already help growers and consultants decide when to spray. With more information coming available, the model will improve and become a reliable decision tool.

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Figure 1: Disease simulation for an orchard in Steiermark (Austria). Most symptoms and leafdrop occurs in September and October.



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