Marc Trapman
Consultant and RIMpro developer, Bio Fruit Advies, the Netherlands
marc.trapman@biofruitadvies.nl

Effective scab management in 2014 using RIMpro

Info

Fungicide service
Everyone can evaluate his fungicide schedule with RIMpro. For users running their own station on the RIMpro Cloud this is a standard feature. Who uses RIMpro over his advisory service can easily subscribe for this extra service. Schedules for several orchards can be administrated and viewed.

Apple Scab is the key disease in apple production. Either measured in potential economic loss or costs and efforts necessary for its control. The apple scab model available on the RIMpro Cloud Service has proven its value over the past 20 years. In 2014 every fruit grower and adviser can connect his weather station(s) to this service.

The apple scab fungus rules the life of fruit growers and their advisers. Every rain event has to be judged for its consequences. Mostly there is only one right decision to make, and only one moment for the perfect application. Uncertainty leads to more fungicide treatments than necessary or damage by scab. So in either case to higher costs. RIMpro helps to make the best decisions. The graphs show the current situation and the development in the coming hors and days using local weather forecast. The service offers the possibility to register spray schedules, and estimate the cover remaining from the last fungicide treatment.

Inadequate management of the key infections undoubtedly leads to scab damage. *EFM*

Understand the infection process

The RIMpro graph shows the relative importance of primary scab infections. (Figure 1) Three high peaks mark the major scab infections, followed by a few smaller ones. Infection values under 100 are considered light, till 300 moderate, and over 300 as severe infection risk. Scab infections with RIM values over 600 occur only a few times per year and are the key infections. Inadequate management of these infections undoubtedly leads to scab damage.
Figure 2 shows an infection event in detail. In the middle graph you see in red the proportion of the ascospore potential ready to be ejected during next rain. The actual spore discharge is presented as yellow bars. The following 'white cloud' in the graph represents the spores that try to germinate. Depending on the temperature it takes them up to 40 hours to germinate and infect the leaf. When leaf wetness stops earlier the spores survive for some time, but eventually die without infecting the leaf. This happens to the spores discharged on April 29.
When wetness continues the spores germinate and penetrate the leaf. This is the moment of infection. (red line). The more spores infect the leaf, the more severe the infection is, and the higher the RIM value.
Once under the cuticle the fungus starts growing. The first 200-300 Degree Hours (DH) the mycelium is still small and vulnerable. Products like Dodine, Lime Sulphur and Potassium Bicarbonate can still kill the fungus and stop the in-

Curative fungicides can stop the growth of the fungus in the leaf until a certain development stage. *EFM*

fection. This stage is the orange zone following the red infection line in the graph.

At what stage do fungicides work

Contact fungicides like captan and sulphur kill spores during the germination process. These are the spores in the white cloud in the graph, which is called the germination window. Contact fungicides can be put on before the rain, but only the residue still present after the rain during the germination window is active. A contact fungicide applied during the germination window is the most effective treatment to stop an infection. Only than you hit the moment of action of these fungicides and bring the full dose of your application to work.

Dodine and Lime Sulfur are both effective during the germination window, and have limited curative efficacy till about 300 DH after start of infection. The mode of action of potassium bicarbonate however is only curative and it is easily washed off by rain. That narrows the window of application for potassium bicarbonate down to the first 300 DH after the infection. Systemic fungicides have no effect on germination but can stop the development of the fungus in the leaf up till 1000 DH post infection.

Resistance: game over!

Most commercial important apple varieties are highly susceptible to scab. Organic fruit growers moved to modern Vf scab resistant varieties to realize low input production, and ease their life. Unfortunately scab races breaking the Vf resistance have developed in most European production areas leaving the Vf varieties as susceptible as the standard apple varieties. As it is now, all commercial important apple varieties have to be regarded as susceptible and should be protected well. There is no room for thresholds as failures in spring lead to extra treatments in summer compromising the goal of environmentally friendly and residue low production.

Decline of cover

RIMpro estimates the decline of the fungicide cover by leaf growth and wash-off by rain. Leaf growth is calculated from temperature, and wash-off is depending on the fungicide. Strobilurins are not washed off as they are fixed in the wax layer of the leaf. Copper en dithianon are quite rain-resistant, while sulphur and especially potassium bicarbonate are washed away by rain lightly.

How to do it

Each infection event is different. Weather, orchard history, phenological stage, RIM value, and previous treatments, create a unique situation every time again. RIMpro supports decisions by showing the infection event and how it will develop based on weather forecast. It also estimates what is left of the cover of the previous fungicide treatment. Keeping in mind all written above, the following decision rules apply to practical scab management:

1. *Eight-hour reaction time.* Equipment and availability of labour should be such that the whole farm can be treated within 8 hours.
2. *Build on contact fungicides.* Use systemic fungicides only as last resource.
3. *No calendar sprays.* These have no relation to the infection biology, and make it harder to decide on the real important moments.
4. *Pre-rain preventive treatment.* When an infection is forecasted, cover as shortly as possible before the rain. This can be an alternate row application if you are capable of treating the other rows during the germination window.
5. *Germination window treatment.* As soon as an infection is likely to develop, and the remaining cover is less than 30% for a light, or less than 50% for a severe infection. If the previous treatment was alternate row, it should always be repeated now. A germination window treatment is highly effective even when applied during drizzle rain.
6. *Stop-curative treatment.* If you could not spray during the germination window, or the infection becomes more severe than expected, a stop or curative treatment is necessary. Infections with a RIM-value over 600 should always be treated double! Organic fruit growers use lime sulphur or a combination of sulphur and potassium bicarbonate on wet leaves to stop the infection in the 300 DH post infection window. Integrated fruit growers that still trust modern systemic chemistry would apply a combination of a contact and a systemic fungicide within 1000 DH.
7. *Cleaning up during on-going infections.* Infections developing from successive days of rain are more complicated to handle. Most spores are released during the first two rainy days. This situation does not need a succession of curative sprays. Keep in mind that a contact fungicide will 'clean the leaves ' from germinating spores, and "zeros" the situation. Don't hesitate to spray on wet leaves. This is always better than waiting for dry weather and rely on curative chemistry.

Figure 1. RIMpro clearly distinguishes between major and minor infection events. New in the graph is the orange zone after the infection. In this stage the primary stroma is formed and the fungus is still susceptible for materials with limited curative activity like Lime Sulphur and Potassium Bicarbonate.

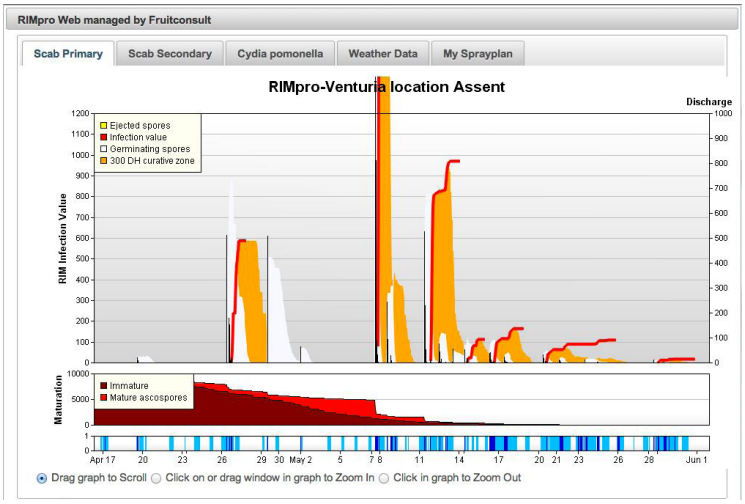


Figure 2. Ascospore discharge is presented and yellow bars. The discharge on April 26 causes an infection (red line). The spores discharged on April 29th die without causing an infection as the leafs dry quickly.

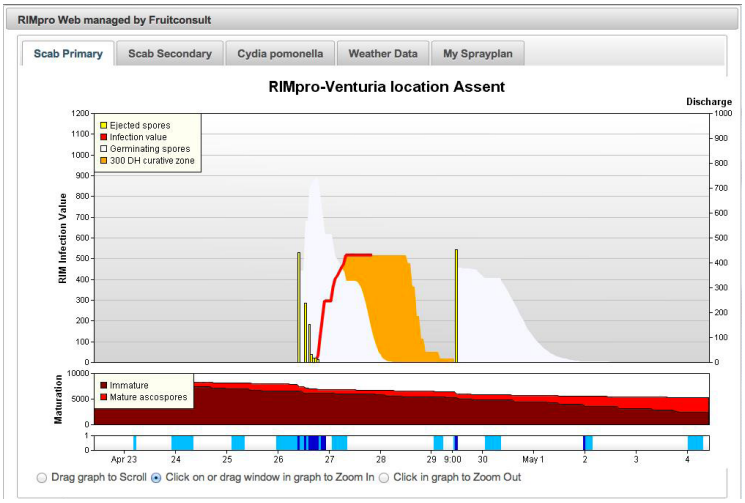
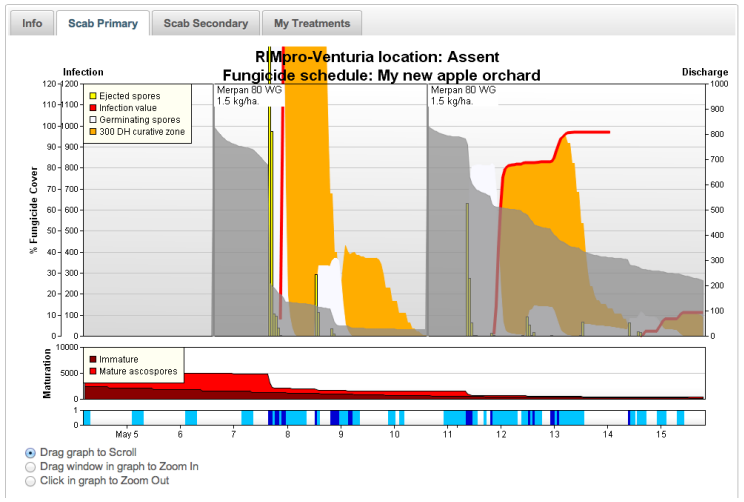


Figure 3. Users can administrate their fungicide schedule. In this example the first protective treatment is washed away by the rain that is causing the infection. Scab management will fail unless another stop or curative treatment is made. The second treatment provides enough cover throughout the infection event.



Another unfortunate fact is that the scab fungus develops resistance against fungicides. All over Europe scab populations have developed that are less susceptible to all groups of systemic fungicides. The practical consequence is that scab management should be based on the accurate application of contact fungicides.
When yet even the number of applications of these contact fungicides is limited by label restrictions it is obvious that effective scab management becomes precision work.

The power of numbers

We don't like it, but there is a lot of chance involved in scab control. Eventually the number of spores that escapes our management and successfully infects the tree determines the size our scab problem.
Where there was a lot of scab last year, the potential ascospores dose (PAD) is high. This increases the chance that each infection some spores will escape our control. Therefore sanitation measures to get rid of the leaf litter to reduce PAD make every single infection easier to handle while there are less ascospores involved in the infection process.
Even with the best spraying technique there is a factor 15 in fungicide cover between the best en worst covered leaf. This uneven spray cover makes that at moments of high spore release, there is a high chance that some spores germinate somewhere on the tree were the fungicide cover is not good. A double treatment on key infections is not only necessary while you put on two fungicides, but also because the cover is better in two than in one spray round.
In most apple production areas in Europe relying on systemic curative chemistry has become a complete gamble. Growers have absolutely no guarantee that their local scab population is still susceptible to the systemic product.

Curative activity in degree hours

Curative fungicides can stop the growth of the fungus in the leaf until a certain development stage. When it is warm the fungus grows fast, and is out of reach of the curative fungicide earlier than when it is colder. This means that the "kick-back" time of curative fungicides cannot be given in hours but only in Degree Hours. RIMpro presents the kick back of curative fungicides using the actual temperature and the properties of the fungicide.