Rational and site-specific control of apple scab

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Abstract

Scab is one of the main reasons why apple growers use fungicides. The Research Center for Fruit Growing (pcfruit npo) helps growers optimize their spraying schedule by sending out warnings during infection moments. The alerts are based on the climate conditions and the number of ascopores released. This last parameter is determined using a Burkard spore trap placed above captured severely infected leaves that are fixed at ground level at our research center. In this way, all growers receive the same spraying advice regardless of the severity of their apple scab problem. In order to provide more site-specific warnings an IWT-funded research project was started in collaboration with ILVO and KU Leuven. The first objective of this project is to estimate the starting amount of the scab inoculums site specifically. To this end a molecular technique was developed; the aim is to determine the initial inoculum load based on the amount of Venturia inaequalis *DNA that is detected in leaves just before the start of the scab season. In parallel a prediction will be made based on the number of ascospores that is detected by a forced maturation and release of ascospores before the season starts. Based on the predicted site-specific inoculum pressure, growers can adjust their management strategy during (the beginning of) the season. In the first year of the project, the potential inoculum pressure was determined and correlated with the actual number of ascospores released from the leaves during the season. Actual release during the season was determined using Rotorod spore samplers placed above leaves from different orchards.*

Keywords: apple, initial scab inoculum, actual spore releases, management strategy

Introduction

Apple scab, caused by *Venturia inaequalis* (Cooke) Winter, is one of the most dreaded diseases during fruit production. More than 50 % of all pesticides used in this industry are used to combat scab. Their extensive use results in an increased risk of resistance development and fungicide residue on the fruits and might also have adverse environmental effects. The optimal management strategy is to control the primary infections caused by ascospores (i.e. the sexual spores which are formed in the infected leaves after leaf drop) via a limited number of treatments. This can be achieved very precisely when accurate scab information of individual orchards are available. One way to predict the level of the scab infestation is to determine the size of the initial inoculum present in the fallen leaves at the beginning of the growing season. The most precise method to determine the amount of scab in these leaves is by molecular techniques (Gusberti *et al*., 2012). Here, we show data on the forced ascospore release (Aylor, 1996)

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at the beginning of the season and their correlation with the actual releases during the growing season.

Material and Methods

In December 2014, fallen leaves were randomly collected at 10 different orchards. Three of these orchards were managed according to the "Integrated Pest Management (IPM)" manual while the others were from organic producers. Leaves were put into mesh bags (60 cm x 60 cm) and stored outdoors nearby pcfruit *npo*. During the first 2 weeks of March, 40 leaves of each orchard were kept at 20 °C and 60 % relative humidity in order to force the maturation of the ascospores. Before the first ascospore releases in the field, artificial releases were carried out in the laboratory. To this extent, 10 leaves were located on top of a funnel supported by a plastic mesh (figure 1a) and this in quadruplicate for each condition. By creating a vacuum under the leaves, which were moistened every 30 minutes during 2 hours, ascospores could be collected in an Eppendorf tube (0.2 ml) (figure 1b).

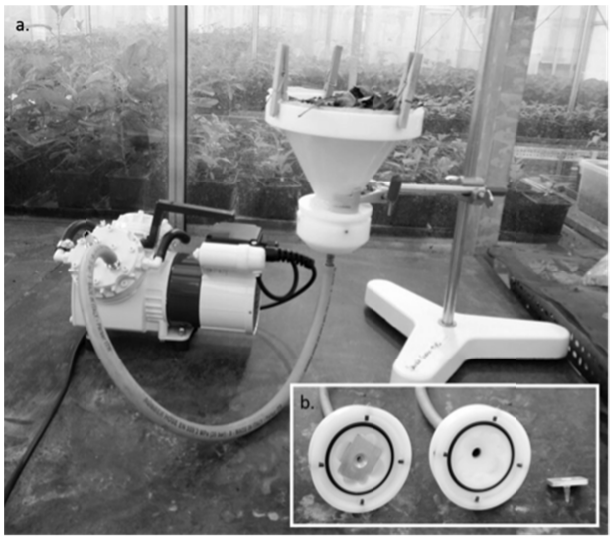

Figure 1: Design of an artificial ascospore release setup with a) the spore trap and vacuum pump and b) the mechanism of ascopore capturing.

The actual ascospore releases in the field were monitored using Rotorod spore traps from April 11th until May 9th. Rotorods were placed 30 cm above the mesh bags filled with leaves. The plastic rods were covered with vaseline in which the ascospores were trapped. For practical reasons only one replicate per condition was used. After every rainy day, the numbers of spores on the 2 rods of each Rotorod were counted microscopically.

Results and Discussion

Figure 2 shows the total number of captured ascospores from April 11th until May 9th above the 10 mesh bags. The first 3 bars represent the counted ascospores from leaves collected at 3 different IPM orchards. More ascospores were present in the leaves coming from the orchards of organic growers (BIO). The apples harvested in orchard "BIO 7", which had the highest number of ascospores released, were covered with scab after storage. Figure 3 shows the relation between the actual number of ascospores released (figure 2) and the predicted amount of starting inoculum at 4 selected orchards (i.e. IPM 2, BIO 1, BIO 3 and BIO 7). The data are well correlated, so it can be concluded that the actual ascospore release can be predicted by a forced ascospore release before the start of the growing season.

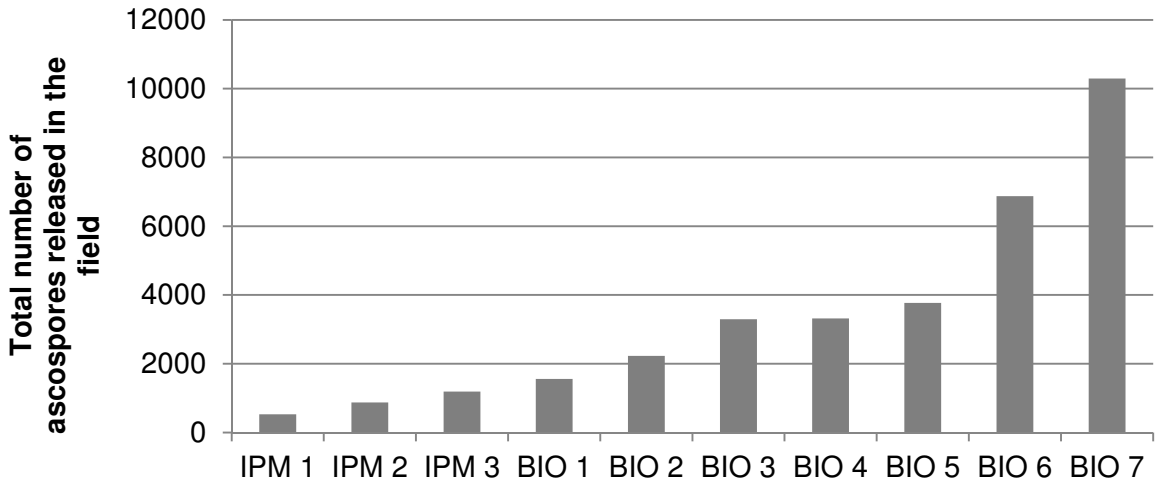

Figure 2: Total number of ascospores counted using Rotorod samplers from April 11th until May 9th above 10 mesh bags filled with leaves collected at 3 IPM orchards and 7 organic (BIO) orchards. Each mesh bag (60 cm x 60 cm) consisted of 3600 cm^2 sampled leaf material.

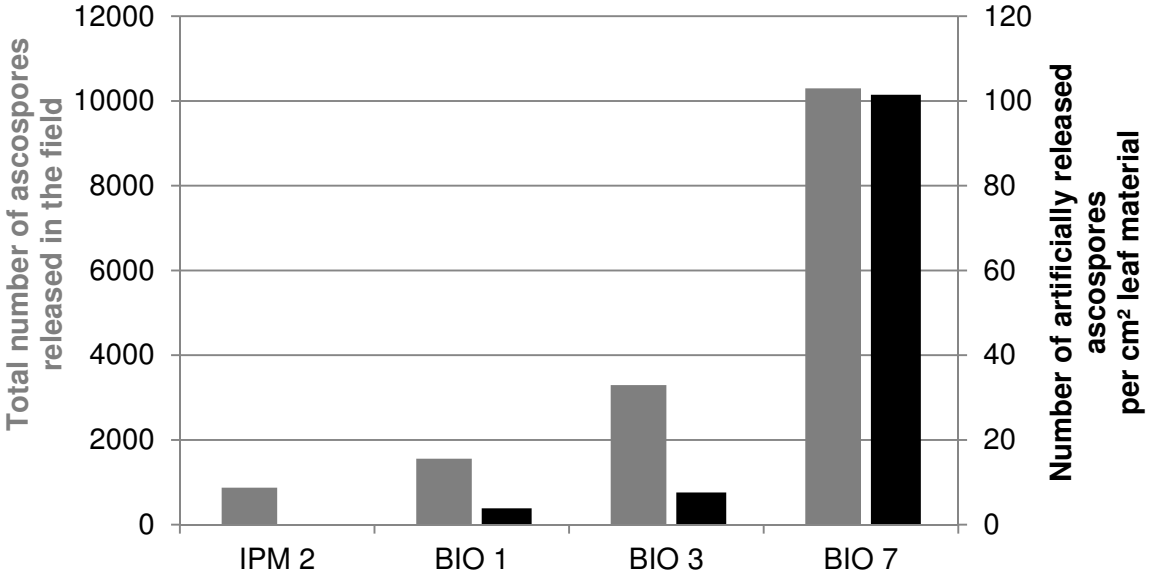

Figure 3: Relation between the number of ascospores released above the mesh bags of 4 growers (see figure 2) and the predicted amount of inoculum displayed as the number of artificially released ascospores per cm^2 leaf material.

Acknowledgements

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