Project Title:
Evaluating an ascospore release forecasting model and orchard disease monitoring methods for improving apple scab management.

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Objectives and Rationale

Apple scab caused by *Venturia inaequalis* is a disease of major economic importance. Although disease management is effective in most years, substantial losses can occur. This is likely due to our inability to identify severe primary infection events, since the currently used disease prediction model (iLeaf) only uses weather parameters, and not ascospore quantities. The RIMpro forecasting model can improve predictions since it takes both parameters into account. An important factor that determines the severity of primary scab infections is the potential ascospore dosage (PAD), which is determined by scab severity in fall. The three objectives of the study were to (i) establish a method for determining the biofix (first ascospore release of the season), which is required as an input parameter for running RIMpro, (ii) validate the RIMpro model in South Africa and (ii) to evaluate different grower based PAD methods.

Methods

The biofix was determined in nine orchards over two seasons (2016/17 and 2017/18) using scabbed leaves overwintered in plastic mesh bags or Triloff traps. The RIMpro model was validated in three to five commercial orchards in three seasons (2015/16 to 2017/18), and in the last two seasons also in an experimental ARC orchard. Trap trees and Rotorod spore samplers were used to determine the severity of scab infections and ascospore release respectively, during infection events. A qPCR method was developed for quantifying ascospores from Rotorod samplers. Three grower based PAD methods were evaluated in seven orchards over two seasons; a MacHardy leaf counting method, a European percentage infected shoots method using 25 trees, and a modified European method using 60 trees.

Key Results

The biofix could only be identified in the ARC experimental orchard in the two assessed seasons using leaves overwintered in plastic mesh bags. The RIMpro model only indicated one to four infection events per season, whereas the iLeaf model indicated many more infection events. The RIMpro model was very accurate in the 2015/16 season in commercial orchards based on trap tree data and ascospore quantifications. RIMpro was not accurate in predicting trap tree infections and ascospore release patterns in the 2016/17 season in commercial orchards. In the 2017/18 season RIMpro was accurate in prediction the two most severe infection events, based on trap tree infections. Ascospore release patterns in the 2017/18 season could not be determined since *V. inaequalis* DNA quantities on spore samplers were too low to accurately quantify. The presence of low ascospore inoculum was also supported by low disease severities on trap trees in all of the orchards in the 2017/18 season. In the experimental ARC orchard, RIMpro was inaccurate in predicting trap tree infections and ascospore release. Evaluation of three grower based PAD methods showed that there was a good correlation between the methods. However, the MacHardy leaf counting method revealed larger differences in PAD between some orchards than the European methods.

Conclusion and Discussion

The RIMpro model has potential for predicting severe apple scab infection events. It is unknown why the model was inaccurate in commercial orchards in the 2016/17 season. The

latter along with the fact that the three evaluated seasons were very dry and not conducive to scab development, are reasons why RIMpro requires further evaluation under South African conditions. The ARC experimental orchard, due to high annual scab incidences, likely involves asexual reproduction, which explains the inaccuracy of RIMpro in the orchard. The inability to detect the biofix in commercial orchards and low ascospore quantities on Rotorod samplers in the 2016/17 and 2017/18 seasons in the commercial orchards suggest that ascospore inoculum levels were low, irrespective of high fall scab levels.