Fruit Disease Forecasting Using Kentucky Mesonet Weather Data

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For a number of years, the University of Kentucky's Agricultural Weather Center has offered weather-based disease prediction models for the benefit of apple and grape producers in making disease management decisions. Until this year, predictions of disease models for fruit crops have been based on weather data available from fifteen National Weather Service (NWS) stations located throughout Kentucky. However, disease predictions that have a greater geographic "reach" throughout the commonwealth are now possible. This is because of the growth in recent years of Kentucky's mesonet weather system.

The Kentucky mesonet is a research grade network of automated weather and climate monitoring stations being developed by the Kentucky Climate Center at Western Kentucky University (http://www.kymesonet.org/). The Kentucky mesonet currently includes 56 weather stations, with more expected as funding permits. If we base fruit disease predictions on mesonet-based data instead of NWS data, we can use all 56 mesonet weather stations to feed into the models. Using the data in all these mesonet stations should result in improved disease prediction for fruit producers, since there are more likely to be nearby weather stations in the mesonet network than the NWS network.

However, before switching our disease predictions to mesonet-based data, we wanted some assurance that the weather data feeding into the models would be similar between the two systems. We conducted a series of analyses, but we'll only present two here for the sake of brevity. In both cases, we focused our analyses on estimating the duration of leaf wetness periods, for the following reasons:

• Wetness of surfaces of leaves, flowers, and fruit is essential for infection by many plant pathogenic fungi and bacteria. Many, many disease models for crops all over the world are based in some way on estimating leaf wetness duration, including the models we make available to apple and grape growers through the UK Cooperative Extension Service.

• Estimating leaf wetness duration is notoriously difficult and imprecise, much more difficult than measuring air temperature or rainfall.

For our analysis, we gathered weather data for the period 8 Apr to 2 Oct 2010 at UK's Research and Extension Center at Princeton. We used data collected by three weather stations at the same site: the NWS station, the mesonet station, and a Spectrum Technologies WatchDog weather station. (Periodically, during the past dozen years, three WatchDog units – located in Quicksand, Lexington, and Princeton – have provided weather data used to generate fruit disease forecasts issued by Dr. Hartman.) Results of the two analyses selected for inclusion in this article are shown in Figures 1-2.

In Figure 1, it is clear that estimates of leaf wetness using Mesonet data correlate to those obtained using the NWS station. Variance is clearly present in those estimations, and in some instances the difference in estimated duration of leaf wetness is substantial. However, there is no evidence of a significant systematic bias in the estimation of leaf wetness between those data sources.

In Figure 2, one can see that leaf wetness estimates correlated well between the two data sources used in this analysis. The mesonet data showed a slight tendency to underestimate periods of leaf wetness at values, especially below 5 hr of leaf wetness, but this difference was not large and probably wouldn't be epidemiologically significant for most disease outbreaks.

Conclusion

The growth of the Kentucky mesonet network provides a more comprehensive weather network for prediction of crop diseases than has been previously available. Our analyses suggest that disease forecasts based on these data should be useful to fruit producers. Given the increasing coverage of the mesonet network (with currently 56 stations statewide), we expect that the mesonet system will provide more local, fine-scale resolution than can be obtained with either Spectrum WatchDog units located on UK research stations or NWS weather stations (which currently number 15 statewide). Disease models incorporating mesonet data are available http://wwwagwx.ca.uky .edu/kymesonet2.html. Δ

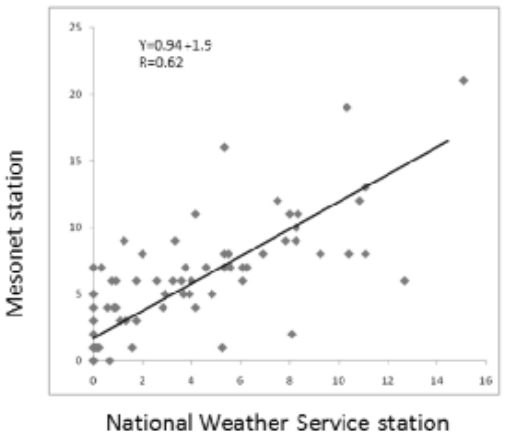

Figure 1. Comparison of estimates of leaf wetness duration obtained using data from two nearby weather stations. These estimates were calculated based on an algorithm employed by the UK Ag Weather Center.

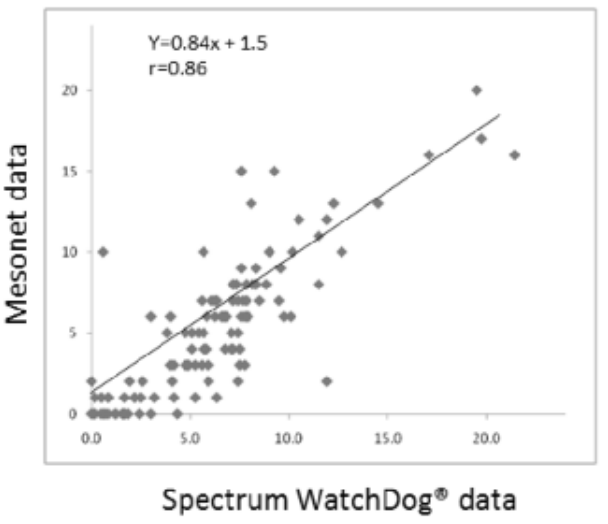

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Figure 2. Comparison of estimates of leaf wetness duration obtained using Mesonet data and a Spectrum WatchDog unit. These were calculated using similar algorithms (although the algorithm used on mesonet data included wind speed, data which were not available in the WatchDog unit).

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