Environmental Monitoring for Disease Management

Many plant diseases are managed with prudent sanitation measures and timely preventative sprays. Fungicides and bactericides should be applied before the pathogen infects the plant. Since predicting the conditions that promote infection is often not well understood or taken into account, this can lead to more "insurance" sprays than actually needed.   Monitoring and quantifying environmental conditions that promote disease infection and development could be very useful in predicting disease risk and helping time preventative sprays or other management practices.

Humidity and leaf wetness are especially important environmental factors that influence whether or not a disease will occur. The majority of fungi, aerial nematodes, and bacteria that cause plant diseases require liquid "free" water on the plant surfaces before they can infect the plant. Free water could be in the form of rain, fog, dew, sprinkler irrigation water, syringing water, or even pesticide spray. Moreover, many fungi need high humidity to produce spores. Dew formation is triggered when the surface temperature of a leaf canopy drops below the dew point temperature of the surrounding air. This typically occurs at night in greenhouses that are not ventilated and heated properly or in field or nursery crops on calm clear nights. Often the period that free water exists on the plant can dramatically affect disease severity by enhancing conditions that favor infection. Major leaf and stem pathogens are supported by wet periods of 4 hours or more of continuous leaf wetness.

Commercial disease prediction models exist for apple scab, cedar apple rust, potato late blight, tomato early blight, strawberry anthracnose, botrytis fruit rot, citrus brown spot, lettuce downy mildew, grape powdery mildew, among others. Sensors quantify leaf wetness in the crop leaf canopy, data loggers collect and organize this information, and mathematical models can help predict disease risk. These systems can reduce the number of sprays that are needed for disease control.

Many current greenhouse control systems can help collect and organize data from leaf wetness, relative humidity and temperature sensors. For field and outdoor nursery crops, a simple environmental monitoring system can be pieced together using readily available sensors and dataloggers from various companies (e.g. , Campbell Scientific Inc (Logan, UT), Onset (Bourne, MA), Spectrum Technologies Inc. (Aurora, IL).   Botrytis models have been intensively studied in many crops and should be one of the first to try with these systems.

Field observation and evaluation of disease models is needed to confirm their usefulness for specific crops and conditions. Models that predict high disease risk could improve scouting efficiency by targeting more intensive scouting during these periods, help reduce fungicide applications by predicting optimal timing of fungicides before infection occurs, and target periods when dehumidification cycles are needed in greenhouses.