4.2 DISEASE FORECASTING

Fact Sheet Objectives

- Explain how disease epidemics can be quantified and predicted
- Describe the four requirements for the successful use of forecasting systems

Disease Forecasting

Most disease forecasting systems are used to target fungicide applications to periods when disease risk is high so that unnecessary sprays can be avoided. Others use risk of disease to make decisions on other crop management actions, e.g. bringing harvest date forward in grapes to avoid Botrytis Bunch Rot, or sending high risk fruit to market sooner for Kiwifruit. All forecasting systems use a risk index whose value is monitored.

Methods of disease risk assessment include:

- **Infection recognition;** using weather monitoring to identify "infection periods" when conditions are suitable for disease. These estimate infection efficiency (e.g. Mills periods for Apple Black Spot, Bacchus for Grape Botrytis).

- **Inoculum prediction;** by monitoring suitability of weather for inoculum production (e.g. rainfall for ascospore release prediction for Apple Black Spot, temperature for multiplication of Fire Blight Bacteria in the MaryBlight model).

- **Primary inoculum measurement;** to estimate how much of the pathogen has overwintered which will in turn govern the intensity of fungicide programme that may be required (e.g. Apple Powdery Mildew, Grape Powdery Mildew Flag Shoot, Apple Black Spot potential ascospore dose and Kiwifruit Sclerotinia apothecial density assessments).

- **Saprophytic inoculum measurement;** for diseases with a saprophytic phase, to estimate how much of the pathogen is present in an orchard and to determine the risk of fruit infection. This allows post-harvest fruit inventory management to be optimized (e.g. fruit rots of Kiwifruit).

- **Host susceptibility assessment;** for diseases where susceptibility to infection at certain growth stages is a major determinant of disease risk (e.g. flowering date determines the risk of Botrytis infection in Apples, Grapes and several other crops; berry brix in Grapes determines the likelihood of a Bunch Rot epidemic).

Downy mildew on grape leaf and fruit.

An electronic weather station linked to telephone modems and fitted with a range of sensors.

Disease Forecasting Systems

Weather-based infection recognition systems are the most common type of forecasting system. Weather is monitored and when an "infection period" is recorded a systemic curative fungicide is applied to eliminate infection that has just occurred (e.g. Mills periods for apple black spot).

Although weather criteria have been developed for many diseases, this approach can only be practically used to manage fungicides under certain circumstances. Epidemics of a given disease can behave differently in different climatic regions or between different seasons. Criteria developed overseas may not be useful in New Zealand because of differences in climate, cultivars and cropping practices.

1) Infection conditions must occur infrequently relative to the fungicide application interval required to protect new shoot growth (generally 7-10 days). If infection occurs as frequently as that interval, then there is no scope to alter spray programmes away from a calendar schedule.

2) Availability of primary inoculum must not limit the time of first appearance of disease, otherwise infection periods may be identified without disease appearing, leading to large numbers of false positive predictions.

3) Infection must only occur when infection periods are identified, otherwise false negative predictions will occur and an unexpected epidemic will develop. In reality there will always be an error rate of false negative predictions. Little research has been done to determine how low the false negative rate must be for a forecasting system to be useful.

4) Systemic fungicides must be able to eliminate almost all latent infection. If some latent disease establishes each time there is an infection period, an epidemic may still develop.

Summary

- Disease forecasting systems help to determine whether there is an undetected epidemic that needs to be halted with fungicides, or whether there no risk of an epidemic and therefore no need for fungicides.
- There are four requirements for successful use of infection recognition forecasting systems.

Further information

Disease Epidemiology: Factsheet 4.1 in this series
Weather Monitoring: Factsheets 3.1-3.9 in this series