Disease Forecasting

Pl. Path. 111 (Cr. Hrs. 3+1)

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Classic Disease Triangle

Environment

Pathogen      Host
Disease Forecasting Pyramid

- Environment
- Pathogen
- Host
- Time
Disease Forecasting

Forecasting involves all activities in ascertaining and notifying the farmers in a community that the conditions are sufficiently favourable for certain diseases, that the application of control measures will result in economic gains or that the disease expected is unlikely to be enough to justify the expenditure of time energy and money to be utilized for its control.
Generally forecasting systems are developed against......

- Those diseases which causes economic losses in terms of quality and quantity of the produce e.g., Apple scab
- Those diseases whose occurrence, spread and destructiveness is variable and mostly depends on weather conditions e.g., Potato late blight
- Those diseases whose control measures are known and can be applied effectively and economically by the farmers
- Those diseases whose epidemiology is fully known/studied
Why Use Forecasting Models?

- Alternative to calendar spray programs
- Enhance timing of fungicide sprays to disease development
- Economic benefits (spray reduction)
- Environmental benefits (spray reduction)
4 Stages of a Model

- Purpose of Disease Model
  - Specific disease, crop, climate, & region

- Model Development
  - Assumptions & monitoring variables

- Model Validation
  - Testing the assumptions

- Model Implementation
  - Going public or private
Purpose...

- Models typically are developed in specific climates for specific diseases
  - Early blight model for Midwest tomatoes
- Models may contain assumptions about site specific conditions that might not apply for all areas
  - Early blight in Midwest, but what about the west coast, the desert?
- Variables such as timing of model initiation, host phenology, and host range may effect predictions
  - Host plant resistance; variety & fungicide selection
Basis of disease forecasting

- Forecasts based on amount of initial inoculum
  - Heald (1921) Number of spores on infected grains of wheat
  - Wilhelm (1950) spores of *V. alboatrum* in soil
  - No. of sclerotia an nematodes cysts in soil

- Forecasts based on weather conditions between the cropping seasons
  - Stewart wilt of corn (*E. stewartii*) survive in flea beetle vector, so conditions during Dec to Feb (temp less than -1°C) affect survival
  - Downy mildew of tobacco
Forecasts based on weather conditions (late blight of potato)

- Dutch rules (In Holland)
  - Night temperature below dew points for at least 4 hours (dew)
  - Minimum temperature of 10°C or above
  - Mean cloudiness on the next day of at least 0.8
  - 0.1 mm of rainfall during the next 24 hours

- In England (only two)
  - Minimum temperature of 10°C
  - RH not falling below 75% for at least 2 days
Forecasts based on amount of initial inoculum and weather conditions

* e.g. apple scab
  - Leaf wetness at 6-28°C (9 hrs at 18-24°C)
  - Length of leaf wetness
  - Temperature
  - Amount of initial inoculum
    - Data on temperature leaf wetness and duration of wetness can be used to predict the
      - infection periods
      - Level of disease
Some Disease Forecasting Models

- **EPIDEM**: *Alternaria solani* on tomatoes & potatoes
- **FAST**: Forecasting *Alternaria solani* on tomatoes
- **TOMCAST**: *Alternaria, (Septoria, anthracnose)*
- **WISDOM (BLITECAST)**: Late blight on tomatoes & potatoes
- **MELCAST**: Watermelons (*Anthracnose, gummy stem blight*), Muskmelons (*Alternaria*)
- **Maryblight**: Fireblight on apples
- **EPIVEN**: Apple scab on apples
- **EPICORN**: Southern corn leaf blight
- **North American Blue Mold warning system**: Tobacco
Online disease forecasting models

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<thead>
<tr>
<th>Almond</th>
<th>Lettuce</th>
<th>Strawberry</th>
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<tbody>
<tr>
<td>Shot hole</td>
<td>Downy mildew</td>
<td>Botrytis</td>
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<tr>
<td>Scab</td>
<td>Sclerotinia drop</td>
<td>Powdery mildew</td>
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<tr>
<td>Apple</td>
<td>Pear</td>
<td>Tomato</td>
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<tr>
<td>Fire blight</td>
<td>Fire blight</td>
<td>Powdery mildew</td>
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<tr>
<td>Scab</td>
<td>Scab</td>
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<tr>
<td>Carrot</td>
<td>Pistachio</td>
<td>Tomato, processing</td>
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<tr>
<td>Alternaria leaf blight</td>
<td>Alternaria late blight</td>
<td>Blackmold</td>
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<td></td>
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<td>Late blight</td>
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<tr>
<td>Celery</td>
<td>Potato</td>
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<tr>
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<td>Late blight</td>
<td>Rhizoctonia blight (brown patch)</td>
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<td>Stone Fruit</td>
<td>Walnut</td>
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<tr>
<td>Botrytis bunch rot</td>
<td>Brown rot</td>
<td>Walnut blight</td>
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<tr>
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<tr>
<td>Downy mildew</td>
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Crop: Processing Tomato  
Disease: Late Blight  
Pathogen: *Phytophthora infestans*

**Note:** Before using a model that was not field tested or validated for a specific location, the model should be tested for one or more seasons under local conditions to verify that it will work in the desired location. See "Validation Work" below.

**Model 1 of 1**  
(See also late blight on potato.)

**Model developer and citation**


**Sensor location**
Off-site, at regional weather stations.

**Input variables**
**Environmental:** Daily temperature, rainfall, and relative humidity.
**Calculated:** Average daily temperature in °C (T<sub>av</sub>), daily minimum temperature, average daily relative humidity (RH<sub>av</sub>) and 24 and 48 hour rainfall accumulation (R).

**Pathogen:** Number of sporangia trapped and disease observed in untreated plots placed in strategic locations throughout the tomato growing areas.

**Model description**
This model generates infection potential indexes (IPI) that predict the most probable inoculum increase of *Phytophthora infestans* in the environment. In Italy, IP indexes are used along with indicator plants plus spore traps to warn farmers about when to start spraying. The model does not give recommendations about subsequent fungicide applications.
I gratefully acknowledge the use of some very important photographs given in the textbook “Plant Pathology” by G N Agrios.

I also acknowledge the scientists who spent valuable time in generating information on various aspects of plant pathology and displayed the same on internet for use by students, teachers, and researchers.