

## Websites to brush up on basidiomycete diseases

- Brown root rot (heart rot)

<http://www.apsnet.org/education/LessonsPlantPath/BrownRootRot/default.htm>

- Common bunt of wheat

<http://www.apsnet.org/education/LessonsPlantPath/StinkingSmut/default.htm>

- Stem rust of wheat

<http://www.apsnet.org/education/LessonsPlantPath/StemRustWheat/default.htm>

- Rhizoctonia diseases of turf

<http://www.apsnet.org/education/LessonsPlantPath/Rhizoctonia/default.htm>

## Disease development in populations of plants

- How fast? *speed*
- *How many?* *efficiency*
- How far? *movement*

## When asking questions of how fast, how many and how far, the distinction between monocyclic and polycyclic disease is very important

### Recall:

**Polycyclic disease** – a disease where one to many cycles of infection are initiated by secondary inoculum

- Many foliar diseases (e.g., powdery mildews and rusts of grasses) are polycyclic

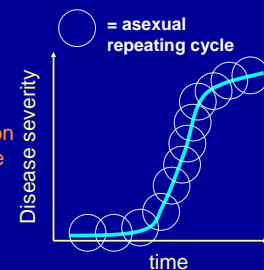
**Monocyclic disease** – a disease where infections are caused by primary inoculum only

- Soilborne diseases are typically monocyclic
- Diseases of specific growth stages are monocyclic (smuts, fruit rots)

## The Late Blight Epidemiology video dealt with the question of 'how fast?' for a polycyclic pathogen

### Disease progress curve

The amount of disease plotted as a function of time; requires information on disease severity over the course of the epidemic.

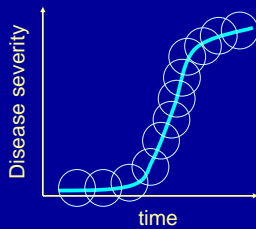


### Questions:

Why is the curve S-shaped?

Why is the generation-time (latent period) important?

○ = short latent period      ○ = long latent period

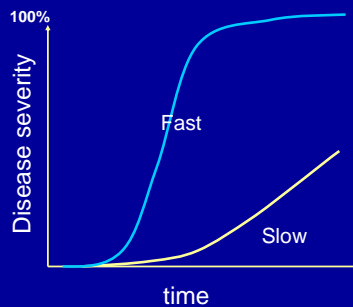
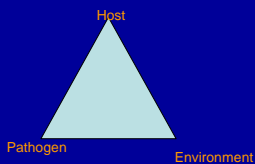


### Phases of a polycyclic epidemic

- **exponential phase** (up to 1% disease) - speed of increase is **limited by supply of pathogen propagules** – disease is increasing rapidly (100-fold increase is common) but is unobserved because the overall amount of disease is so small.
- **logistic phase** – speed of increase most **limited by environment**. During this phase, disease increases from 1 to 50% (50-fold increase).
- **terminal phase** (50 to 100%) - speed of increase is most **limited by the amount of host tissue**. Most damage is done to the crop during the terminal phase, but only a 2-fold increase in disease.

### Polycyclic diseases are best managed by reducing speed

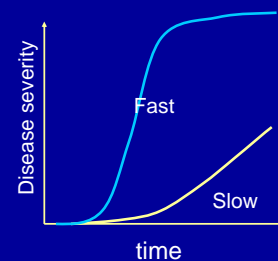
Use the disease triangle as a guide to thinking about epidemic speed



### Questions:

How can the environment influence epidemic speed?

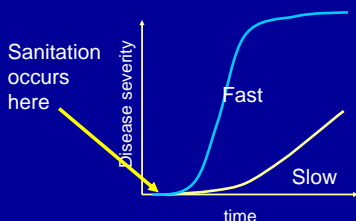
How can host cultivar increase or decrease epidemic speed?



**Question:**

All other things being equal, will reducing the amount of overwintering pathogen (primary inoculum) *slow* the epidemic?

Note this idea is termed 'Sanitation' – the degree to which the amount of primary inoculum can be reduced by a management action

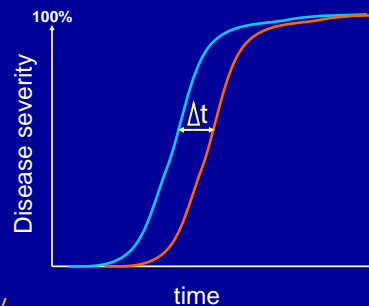


**For polycyclic diseases, reducing primary inoculum with sanitation is not always a tremendous value**

Second curve was generated after an 80% reduction in primary inoculum.

Result: Epidemic was delayed by 8 days

Assumes 'infection rate',  $r = 0.2$  per day



**In polycyclic diseases, the 'infection rate' ( $r$ ) governs the value of sanitation**

delta t is delay in disease epidemic as a result of sanitation

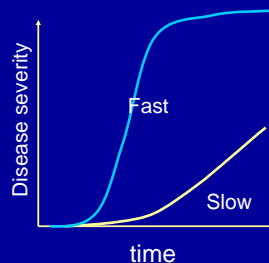
$\Delta t$  is proportional to inverse of ' $r$ '

One divided by infection rate ' $r$ '

- think of ' $r$ ' as a potential birth rate of new lesions/infections
- it is also our measure of potential epidemic speed
- a high value of ' $r$ ' rate results in small benefit from sanitation
- a small ' $r$ ' results increases the value of sanitation

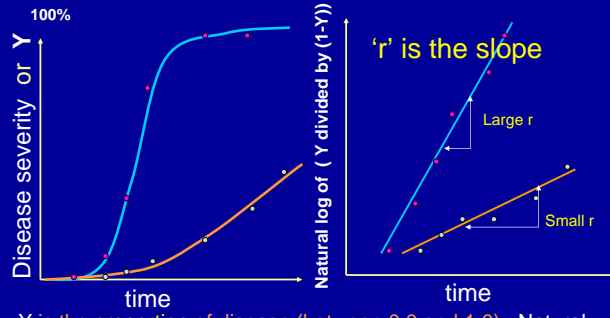
**Question:**

How do we visualize (or estimate) this idea of 'infection rate'?



## Estimation of the infection rate, $r$

1) Measure disease over time 2) Visualize graphically 3) Transform data & compute slope



$Y$  is the proportion of disease (between 0.0 and 1.0). Natural log of  $(Y \text{ divided by } (1-Y))$  is known as the logit transformation