Title: Virus Diseases of the Grapevine
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Virus Diseases of the Grapevine
Lecture 1

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Topics to be covered

• Brief overview of viruses
• Grapevine virus diseases
• Conditions which mimic virus disease symptoms
• Management of grapevine virus diseases
<table>
<thead>
<tr>
<th>Event</th>
<th>Deaths (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS Pandemic</td>
<td>20 (dead) + 40 (living with HIV)</td>
</tr>
<tr>
<td>Influenza/Flu Pandemic</td>
<td>20-40</td>
</tr>
<tr>
<td>(1918-1919)</td>
<td></td>
</tr>
<tr>
<td>Black Death/Plague</td>
<td>20-25</td>
</tr>
<tr>
<td>(1348-1350)</td>
<td></td>
</tr>
<tr>
<td>World War II</td>
<td>15.9</td>
</tr>
<tr>
<td>(1937-1945)</td>
<td></td>
</tr>
<tr>
<td>World War I</td>
<td>9.2</td>
</tr>
<tr>
<td>(1914-1918)</td>
<td></td>
</tr>
</tbody>
</table>
Humans are in a constant battle with viruses.

Severe Acquired Respiratory Syndrome (SARS) epidemic.
Humans are in a constant battle with viruses

HIV/AIDS pandemic
Mass cull of sheep due to Foot-and-Mouth Virus crisis

2001 Epidemic in United Kingdom
Viruses cause damage to agriculture
Some examples of crop losses due to viruses

<table>
<thead>
<tr>
<th>Crop</th>
<th>Virus</th>
<th>Countries</th>
<th>Loss/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Tungro</td>
<td>SE Asia</td>
<td>$1.5x10^9</td>
</tr>
<tr>
<td>Rice</td>
<td>Ragged stunt</td>
<td>SE Asia</td>
<td>$1.4x10^8</td>
</tr>
<tr>
<td></td>
<td>Hoja blanca</td>
<td>S. &amp; C. America</td>
<td>$9.0x10^6</td>
</tr>
<tr>
<td>Barley</td>
<td>Barley yellow dwarf</td>
<td>UK</td>
<td>£6x10^6</td>
</tr>
<tr>
<td>Wheat</td>
<td>Barley yellow dwarf</td>
<td>UK</td>
<td>£5x10^6</td>
</tr>
<tr>
<td>Potato</td>
<td>Potato leafroll</td>
<td>UK</td>
<td>£3-5x10^7</td>
</tr>
<tr>
<td></td>
<td>Potato virus Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Potato virus X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarbeet</td>
<td>Beet yellows</td>
<td>UK</td>
<td>£5-50x10^6</td>
</tr>
<tr>
<td></td>
<td>Beet mild yellows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus</td>
<td>Citrus tristeza</td>
<td>Worldwide</td>
<td>£9-24x10^6</td>
</tr>
<tr>
<td>Cassava</td>
<td>Africa cassava mosaic</td>
<td>Africa</td>
<td>$2x10^9</td>
</tr>
<tr>
<td>Many crops</td>
<td>Tomato spotted wilt</td>
<td>Worldwide</td>
<td>$1x10^9</td>
</tr>
<tr>
<td>Cocoa</td>
<td>Cocoa swollen shoot</td>
<td>Ghana</td>
<td>1.9x10^8 trees*</td>
</tr>
</tbody>
</table>

*Number of trees eradicated over about 40 years
Viruses are very much a part of life on earth.
Viruses are different

Virus

Bacterium

Electron microscope pictures
Viruses are sub-microscopic infective agents

logarithmic, metric scale
The size of viruses relative to different pathogens

**Leafroll virus**
- Length: 1/500\(^{th}\) of a millimeter
- Diameter: 1/90,000\(^{th}\) of a millimeter

**Fanleaf virus**
- Diameter: 1/40,000\(^{th}\) of a millimeter
Viruses have different shapes and sizes:

- **Rod-shaped**
  - Long, highly flexuous (Leafroll virus)
- **Spherical**
  - (Fan leaf virus)
- **Bullet-shaped**
- **Pleomorphic**
  - Short, moderately flexuous (Stem pitting virus)
Viruses have simple genomes

Rod shaped viruses

Spherical viruses

Viral genome (RNA or DNA)

Coat protein

RNA: Ribonucleic acid
DNA: Deoxyribonucleic acid
Viruses: How do they spread?

- Pollen
- Contact
- Seed
- Vegetative propagules
- Exudates
- Contact root grafts
- Mites
- Insects
- Man
- Man
- Fungi
- Nematodes

Ground level
The effectiveness of the different means of virus spread

<table>
<thead>
<tr>
<th>Method</th>
<th>Local</th>
<th>Distant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Seed transmission</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Pollen transmission</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Active vectors</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Less active vectors</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Vegetative propagation</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Soil-borne</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>
Can we control viruses?

• No direct method to control viruses
  (e.g. fungicidal chemicals to control fungal diseases, antibiotics to control bacterial infections)

• Control methods for viruses are indirect to:
  avoid infection
  prevent infection
  limit spread by insect vectors

• Prevention is better than cure
Holistic approach to prevent losses due to viruses

- Understand the nature of virus characterization
  strains/variants
diagnostic tools
- Find the mode of transmission
  insect vector
  seed
  vegetative cuttings
- Learn ecology and epidemiology
  spread of virus in time and space
  cultural practices
  vector behavior
- Deploy resistant/immune varieties through breeding