May 22nd, 3:00 PM - 4:30 PM

Empower research through comparative genomics & next-gen sequencing

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Empower research through comparative genomics & next-gen sequencing

Li-Jun Ma

UMass Center for Clinical and Translational Science

3rd Annual Research Retreat

May 22 2012

Hoagland-Pincus Conference Center, Shrewsbury MA
Disclosure

for Presentations at ACCME
- Accredited Conferences
DISCLOSURE

• I have no actual or potential conflict of interest in relation to this program or presentation.
Fusarium keratitis outbreak associated with contact lenses
**Fusarium oxysporum** – a fungus

- Macroconidia
- Microconidia
- Chlamydosporo
An emerging human pathogen

- Localized skin or corneal infections
- Cause disseminated infections in immunocompromised patients
- Difficult to control (resistant to antifungals), often lethal outcome
Understand pathogenicity using genomics???
Wilt diseases caused by *F. oxysporum*
formae specialis – host specificity

• Each *forma specialis* consists of strains with ability to cause wilt on a unique host or a set of plant host species.

• More than 120 *formae speciales*. 
Comparative genomics

- F. verticillioides
- F. oxysporum
- F. graminearum
- F. solani
- Verticillium dahliae
- Magnaporthe grisea
- Neurospora crassa
- Aspergillus nidulans

0.1 substitution per site
Genomic Structural Difference

<table>
<thead>
<tr>
<th>Species</th>
<th>Genome Size (Mb)</th>
<th>Number of Chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F. \text{ verticillioides}$</td>
<td>42</td>
<td>11</td>
</tr>
<tr>
<td>$F. \text{ oxysporum}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. sp. lycopersici</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F. \text{ graminearum}$</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>$Nectria \text{ haematococca}$</td>
<td>52</td>
<td>17</td>
</tr>
<tr>
<td>(F. solani)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pairwise comparison revealed highly conservation genome structure.
Pairwise comparison defines lineage-specific chromosomes in *F. oxysporum f. sp. lycopersici*
Linage specific chromosomes in *F. oxysporum f. sp. lycopersici* (Fol)

- Uniquely present in Fol genome
- Enriched for TE and repeats
- Lack house keeping genes
- Encode virulence factors
- Horizontal transmission introduce disease

*Ma et al 2010 Nature*
Optical maps reveal unique sets of LS chromosomes in plant and human isolates.
Horizontal transfer of lineage-specific chromosomes determines pathogenicity
Tip of the iceberg

- Origin(s) of the LS chromosomes?
- Mechanisms of the transfer?

Many asexual fungal pathogens have variable karyotypes (Kistler 1992)
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