Identification, Occurrence, Incidence, and Associations of New Fungal Pathogens of Coast Live Oak in Southern California

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Goldspotted oak borer
* Agrilus auroguttatus *

*Diplodia corticola*
Valley Center, CA
Wilderness Gardens Preserve (WGP)

San Timoteo Canyon (RLC)

Santa Rosa Plateau (SRP)
Pathogenicity Tests

CONTROL

INOCULATED
Pathogenicity test: *Diplodia corticola* on coast live oak
Pathogenicity test: *Diplodia corticola* on coast live oak

Diplodia corticola: Known contributor to cork oak (Quercus suber) decline in Europe


Objectives

1. Identify fungal species associated with canker symptoms on coast live oak throughout GSOB-infested and uninfested sites in southern California.

2. Determine their pathogenicity in coast live oak.

3. Assess the occurrence and incidence of Diplodia corticola and other potential pathogens throughout these regions.

4. Identify factors that determine their distribution and establishment in relation to GSOB occurrence at the individual and plot level.

5. Assess how these agents may influence mortality of Q. agrifolia in southern California.
Methods

Plot Establishment

• Every tree ≥1 cm DBH and 1.4 m tall measured and mapped
• 45 plots total
Methods Cont.

Sampling

Symptoms

• Trunk bleeding
• GSOb exit holes
• Non-GSOb exit holes
• Crown Symptoms
• Soil
Methods Cont.

Morphological Identification

Molecular Identification: PCR

Internal Transcribed Spacer (ITS)
+ Beta Tubulin (BT) + Elongation Factor (EF)
Plot Level Disease and Mortality Modeling

**Response Variables**
- Cumulative Mortality
- *D. corticola* Incidence
- GSOb Incidence

**Predictor Variables**

*Continuous*
- Basal area
- Oak density
- Annual precipitation
- RH
- $T_{\text{max}}$, $T_{\text{min}}$
- Year since last fire
- Solar Radiation
- Elevation
- Total Canopy Cover
- Tree Diversity

*Categorical*
- Slope Location

**Multiple Linear Regression Analysis**
# Tree Level Disease Modeling

**Response Variables**
- Pathogen Presence
- GSOB Presence

**Predictor Variables**

**Categorical**
- Tree Health
- Presence and severity of symptoms by pathogens, GSOB and other pests (woodpecker, FHAB, etc.)
- Fire scar presence and severity
- Crown position

**Continuous**
- Basal area

**Multiple Logistic Regression Analysis**
Analysis

Co-occurrence of agents in a plot: Association Analysis
• All Pathogens
• GSOB
• Flat-headed apple tree borer
• Western oak bark beetle

\( J = \) Index of association

Colonization of trees by plant tissues: Fisher’s Exact Test
Presence of Each Agent

<table>
<thead>
<tr>
<th>Symptom Type</th>
<th>Tree Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staining</td>
<td>Crown</td>
</tr>
<tr>
<td>GSOB exit holes</td>
<td>Trunk (Base)</td>
</tr>
<tr>
<td>Non-GSOB exit holes</td>
<td>Trunk (1 m from base)</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th></th>
<th>Total trees measured</th>
<th>Total trees sampled</th>
<th>Total samples collected</th>
<th>Total isolates assessed</th>
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</thead>
<tbody>
<tr>
<td>QUAG</td>
<td>857</td>
<td>428</td>
<td>882</td>
<td>1568</td>
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</table>
**Aggressive Pathogens**

- *Diplodia corticola*
- *Diplodia agrifolia*
- *Fusarium solani*


**Weak Pathogens**

- *Dothiorella iberica*
- *Cryptosporiopsis querciphila*
- *Diatrypella verrucaeformis*
- *Phaeoacremonium mortoniae*

<table>
<thead>
<tr>
<th>Variable/Agent</th>
<th>D. corticola</th>
<th>GSOB</th>
<th>F. solani</th>
<th>Do. iberica</th>
<th>Di. verrucaeformis</th>
<th>C. querciphila</th>
<th>D. agrifolia</th>
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<tbody>
<tr>
<td>Staining</td>
<td>+</td>
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<td>non-GSOW exit holes</td>
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<tr>
<td>Fire Scar</td>
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<td>+</td>
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<td>Woodpecker</td>
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<td>Disease Abundance</td>
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<td>Canker Rot</td>
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</table>

Recovery of Fungi by Tree Position

Recovery from Symptomatic and Insect-damaged Trunk Tissues of Coast Live Oak


![Graph showing % Cryptosporiopsis querciphila](image_url)
Coast Live Oak Mortality

Conclusions

• Seven new fungal species pathogenic to coast live oak
  1. *Diplodia corticola*
  2. *Diplodia agrifolia*
  3. *Fusarium solani*
  4. Dothiorella iberica
  5. *Cryptosporiopsis querciphila*
  6. Diatrypella verrucaeformis
  7. Phaeoacremonium mortoniae

  Aggressive

• No association GSOB and *D. corticola* incidence

• (+) Annual precipitation (+) GSOB

• (+) Annual precipitation (-) *D. corticola*
Conclusions cont.

• More than one pathogen present per tree, no association among agents.

• *C. querciphila* is found more frequently in GSOB infested sites, recovered more frequently from GSOB exit holes on the bole

• No significant difference in mortality between sites

• Mortality correlated to GSOB and *D. corticola* incidence
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