# Introduction

- *Phytophthora sojae* is an oomycete pathogen of soybean (*Glycine max*) causing ~$300 M in crop losses annually in the US.¹
- Management of *P. sojae* is through race-specific and/or quantitative (partial) resistance.
- Race-specific resistance (conferred by *Rps*-genes) exhibits a gene-for-gene relationship with the pathogen (Fig. 1).
- In contrast, partial resistance is generally controlled by many genes of small effect.
- Due to the diversity & rapid evolution of *P. sojae* populations, partial resistance is theoretically more durable than race-specific resistance.
- South Korea has been proposed as the origin of the soybean-*P. sojae* pathosystem. Thus, soybean lines from S. Korea may possess high levels of resistance².

## Objectives

Evaluate partial resistance to *Phytophthora sojae* in three populations:

1. 293 breeding lines and cultivars from the OSU breeding program.
2. 91 historically popular North American cultivars
3. 1,392 Plant Introductions from South Korea

## Materials and Methods

1. Screen to select virulent & aggressive *Phytophthora sojae* isolates
   - a. Hypocotyl test
   - b. Tray test³
2. Conduct layer test* on 1,776 lines from three populations (see objectives).
3. Collect data: Root rot score, plant height, root & shoot weight.
4. Extract genotypic Best Linear Unbiased Predictors (BLUP) values.

### FIGURE 1: Example of gene-for-gene resistance.

Resistance occurs only when *Rps* and *Avr* alleles are present in plant & pathogen

### FIGURE 2: Partial resistance exhibits a quantitative distribution

Distribution of root rot score (C2S1 isolate, all lines)

### FIGURE 3: Box-plot of root rot score BLUP values for each population.

OSU breeding lines have the lowest root rot scores (most resistant).

## Results

Root rot score is quantitatively distributed & skewed right. Fig. 2 shows the excess of lines with root rot scores < 2 for inoculation with isolate C2S1 in the first set of inoculations. This indicates possible race-specific resistance to C2S1. Lines with low root rot scores were labeled as “Group 2” and inoculated with a different isolate in the second set of inoculations.

### TABLE 1: Pearson’s correlation between BLUP values.

<table>
<thead>
<tr>
<th></th>
<th>Root Rot Score</th>
<th>Plant Height</th>
<th>Root Weight</th>
<th>Shoot Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Rot Score</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Plant Height</td>
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<tr>
<td>Root Weight</td>
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<td></td>
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<tr>
<td>Shoot Weight</td>
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</tbody>
</table>

Lower left: correlation coefficient.  
Upper right: significance of correlation (p-value).

The four traits are all significantly correlated with each other in group 1 & group 2.

### TABLE 2: Genetic variance of each trait.

<table>
<thead>
<tr>
<th></th>
<th>INOCULATED</th>
<th>NON-INOCULATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root Rot Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Height</td>
<td></td>
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<tr>
<td>Root Weight</td>
<td></td>
<td></td>
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<tr>
<td>Shoot Weight</td>
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</tbody>
</table>

### TABLE 3: Extreme resistant and susceptible soybean lines.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (C2S1 isolate)</th>
<th>Group 2 (C251 &amp; Henry isolates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank(of 1,044)</td>
<td>Line</td>
<td>Root Rot Score</td>
</tr>
<tr>
<td>1</td>
<td>M09-W148</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>PI 424309 A</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>M11-M055</td>
<td>1.5</td>
</tr>
<tr>
<td>1042</td>
<td>PI 398686</td>
<td>9</td>
</tr>
<tr>
<td>1043</td>
<td>PI 398659</td>
<td>9</td>
</tr>
</tbody>
</table>

High levels of resistance are found mainly in the OSU population with some in the South Korean population.

*Based on root rot score BLUP values

## Conclusions & Future Work

- High levels of partial resistance exist in OSU & South Korean germplasm.
- Significant genetic variation and moderate levels of heritability indicate selection for improved resistance is feasible.
- Phenotypic & genotypic data will be combined for association mapping and studies on genomic selection.

## References


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