Evaluation of Photosynthetic traits and their interactions in soybean seedlings infected with *Phytophthora sojae*

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Introduction

- The projected demand for soybean in a changing climate cannot be met with current yield increases
- Soybean seed yield potential can be enhanced by improving its photosynthetic efficiency (PE)
- Higher PE is anticipated to have positive impact on seed yield and biomass in soybean
- Natural genetic variation can be leveraged to improve germplasm for breeding purposes
- Photosynthetic performance is a key indicator of plant health and stress response in soybean, making it critical for breeding resilient varieties

Objectives

- Assess variation in photosynthetic traits in soybean breeding lines pre- and post-Phytophthora Inoculation
- Analyze the interrelationships among multiple photosynthetic traits

Methodology

- **Material:** Eight advanced soybean breeding lines were grown in a greenhouse to evaluate the diversity of photosynthetic traits
- **Traits evaluated:** Light intensity (PPFD-PAR), quantum yield of PSII (ΦPSII), Non-photochemical quenching (NPQ), maximum quantum efficiency of PSII (Fv/Fm) and Linear electron flow (LEF)
- **Timing:** Data was collected at seedling stage using MultispeQ 2.0 both before and one day after inoculation with *Phytophthora sojae*
- **Consistency:** Readings were taken around the solar noon during both stages to ensure consistency in light conditions
- Upper most fully expanded leaves from two different plants per line were measured to obtain an average photosynthetic performance for each trait
- **Statistical analyses:**
  - ANOVA to assess the effects of different factors on the observed photosynthetic variation among the lines: Genotype, treatment, Genotype x treatment interactions
  - PCA to visualize patterns of variations
  - Pearson Correlation analysis to explore relationships among multiple photosynthetic traits before and after inoculation

Results

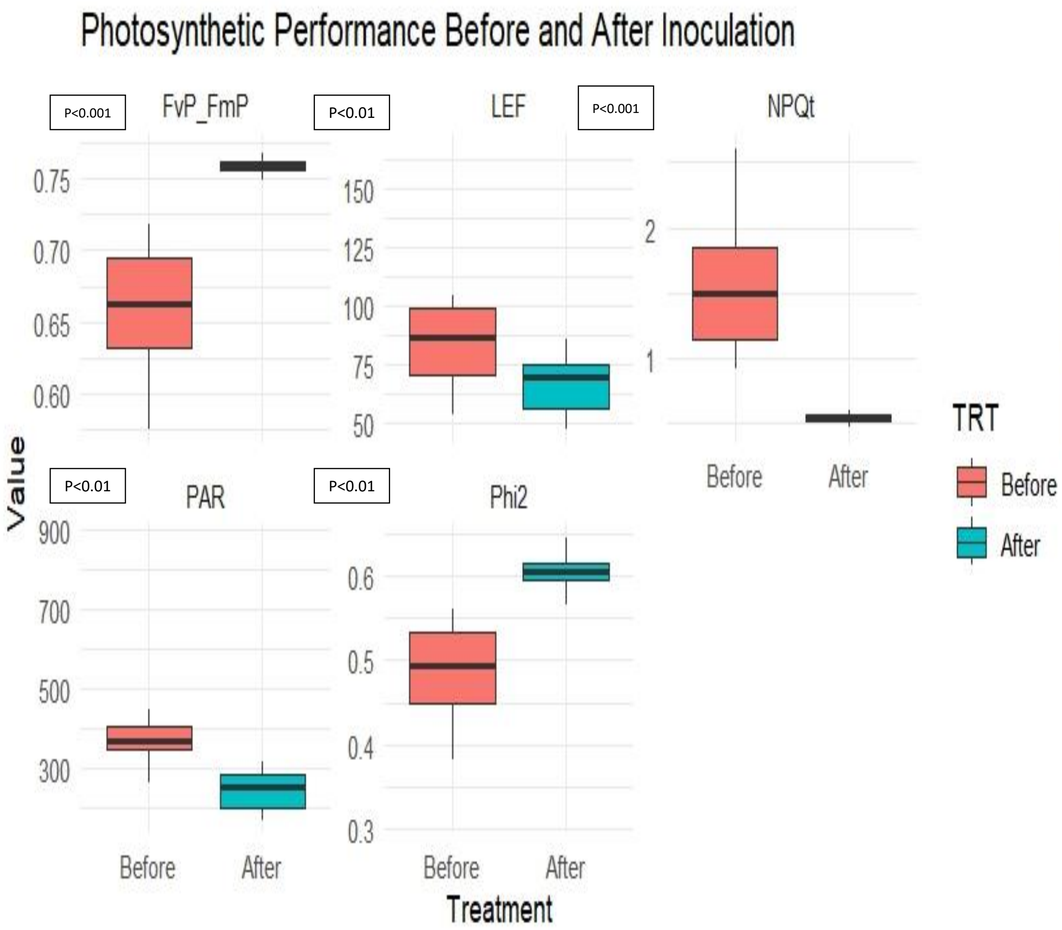

Fig.1: Boxplots showing distribution of PS-traits in breeding lines before and after inoculation

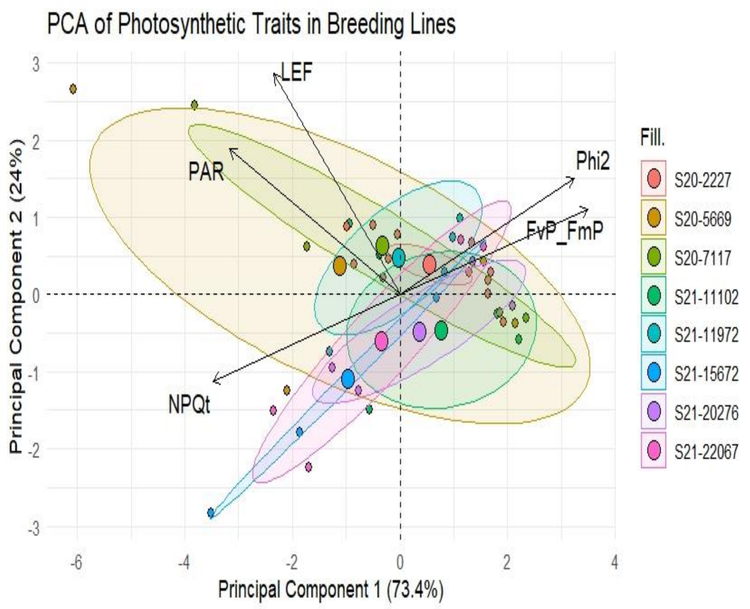

Fig.2: Biplot showing Principal components for different PS traits in breeding lines

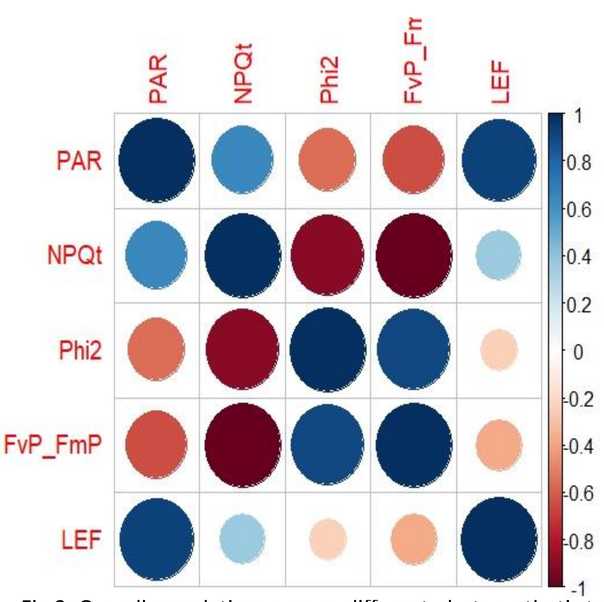

Fig.3: Overall correlations among different photosynthetic traits in breeding lines (all significant at P<0.001)

- Significant variation (P<0.001) among breeding lines was observed for photosynthetic traits including NPQt, Phi2 and FvP/FmP at seedling stage, indicating substantial genetic diversity (Fig.1 & 2)
- Significant Genotype x treatment interactions (P<0.001) for NPQt and FvP/FmP detected, indicating differential responses of breeding lines to Phytophthora inoculation
- Strong correlations among photosynthetic traits were observed (Fig.3), highlighting complex interrelationships (same direction before and after inoculation)
- PAR and LEF showed strong positive correlation; ΦPSII was positively correlated with FvP/FmP but negatively correlated with PAR and NPQt

Conclusions

- Significant variation in multiple photosynthetic traits was observed in soybean seedlings, highlighting genetic diversity
- The correlations among all the traits were quite strong, maintaining consistent direction even after *Phytophthora sojae* infection

Acknowledgments

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