Investigating Treatments for the Management of Macrophomina on California's Central Coast, Field Ratings from 2019

Co-Investigators
Dr. Gerald Holmes
Director
Cal Poly Strawberry Center
1 Grand Avenue
San Luis Obispo, CA 93407
(805) 759-2120
gjholmes@calpoly.edu

Dr. Bo Liu
Assistant Professor, BioResource & Agricultural Engineering Department
California Polytechnic State University, San Luis Obispo, CA
(805) 756-2384
Bliu17@calpoly.edu

Dr. Seyedmojtaba Mansouripour
Postdoctoral Researcher
California Polytechnic State University, San Luis Obispo
(805) 756-6157
smansour@calpoly.edu

Summary

Macrophomina crown rot is a serious concern for the California strawberry industry, especially as fumigation with methyl bromide is no longer possible. The continued establishment and maintenance of multiple field locations in different production regions for conducting Macrophomina crown rot trials is crucial for developing long-term sustainable disease management recommendations. The objective of our research was to screen strawberry genotypes for susceptibility to Macrophomina crown rot. A total of 90 cultivars and elite selections from both public and private breeding programs were planted at Cal Poly in October 2018 and evaluated until August 2019. Plants were inoculated using 5 g Macrophomina cornmeal-sand placed at the crown-soil interface, two weeks after planting.

Plant mortality were assessed over time in both inoculated and non-inoculated plots. Genotype susceptibility varied widely from 4 to 99% mortality with an average mortality of 50.2% and 51.1% for the 24 cultivars common to 2018 and 2019 trials. Each strawberry breeding program has genotypes that are representative of the spectrum of susceptibility. This proposal directly addresses these high priority research areas for the California coastal region: (1) farming without fumigants; (2) control of soilborne diseases; and (5) breeding for disease resistance.

Introduction

Crown rot, caused by the soilborne fungus *Macrophomina phaseolina*, is a damaging pathogen that has become established in California strawberry production areas (Koike et al., 2016). After introduction into a field, the pathogen can cause extensive plant decline and mortality. *Macrophomina phaseolina* can be difficult to manage due to its persistence in soil and crop residues as microsclerotia (Islam et al., 2012). Previous research at Cal Poly has shown that host plant resistance will be a critical tool for managing this disease in the post-methyl bromide era. The objectives of this year's research were to evaluate another set of cultivars and elite breeding lines for their ability to grow in the presence of *M. phaseolina* under field conditions.

Materials & Methods

A replicated field trial was established to evaluate 83 cultivars and elite breeding selections for resistance to Macrophomina crown rot. For year-to-year comparison, 24 of the cultivars in this experiment were also included in 2018's experiment. Strawberry germplasm was selected from six public and private breeding programs: University of California Davis, University of Florida, Driscoll's, Plant Sciences, Inc., Lassen Canyon Nursery and Planasa. The trial was conducted during the 2018-2019 growing season and consisted of 20-plant plots replicated four times, with a fifth non-inoculated replicate. On October 23, 2018, bare-root strawberry transplants were set in field 35b on the Cal Poly San Luis Obispo campus farm. Two weeks later, each plant in the inoculated plots received 5 g of cornmeal-sand inoculum (Mihail, 1992) colonized with three isolates of locally sourced *M. phaseolina* placed at the crown-root interface of each plant.

Host resistance was assessed by recording disease incidence (plant mortality) in each plot. A plant was considered dead when 100% of the foliage was brown and dry. Plant mortality was assessed every four weeks, then every two weeks once symptoms were observed; the last assessment occurred on August 2, 2019. Presence of the pathogen in symptomatic plants was confirmed by plating pieces of the internal crown tissue on acidified potato dextrose agar.

Results

The first wilt symptoms due to infection by *M. phaseolina* were observed on May 30, roughly 200 days after planting. The majority of plant mortality occurred after May 30, when air temperatures reached 90°F (32°C). Genotypes exhibited a wide range of susceptibilities (Figures 1 and 2). Two proprietary genotypes 'LC-A' and 'UC-B' were the most susceptible, with more than 90% mortality by August 2, 2019. Cultivars 'Marquis' and 'Laredo' were the most tolerant genotypes to Macrophomina crown rot, with less than 10% mortality by August 2, 2019.

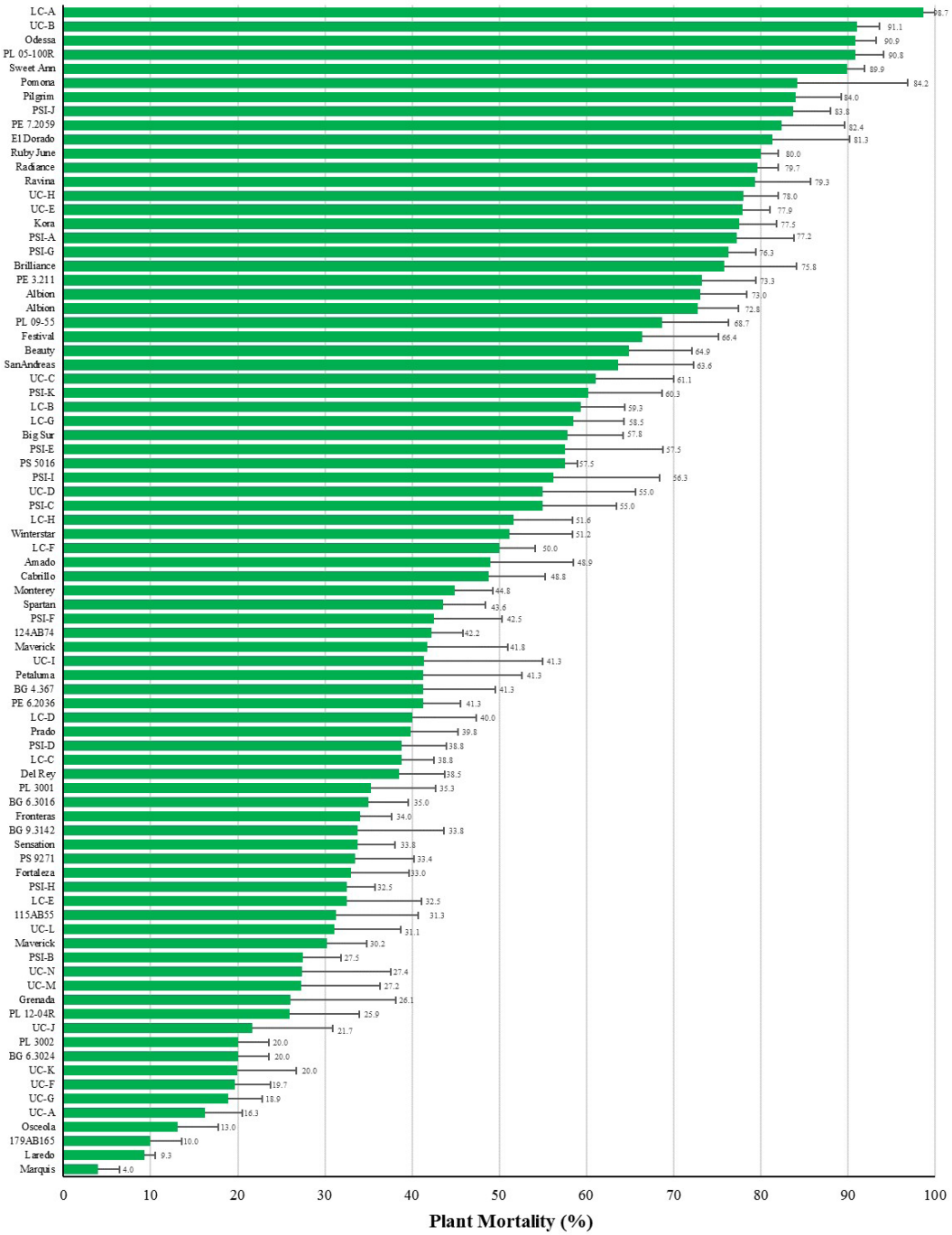

Figure 1. Average percent plant mortality due to Macrophomina crown rot as of August 2, 2019. Cultivars are representative of public and private breeding programs. Error bars represent the standard error of the mean.

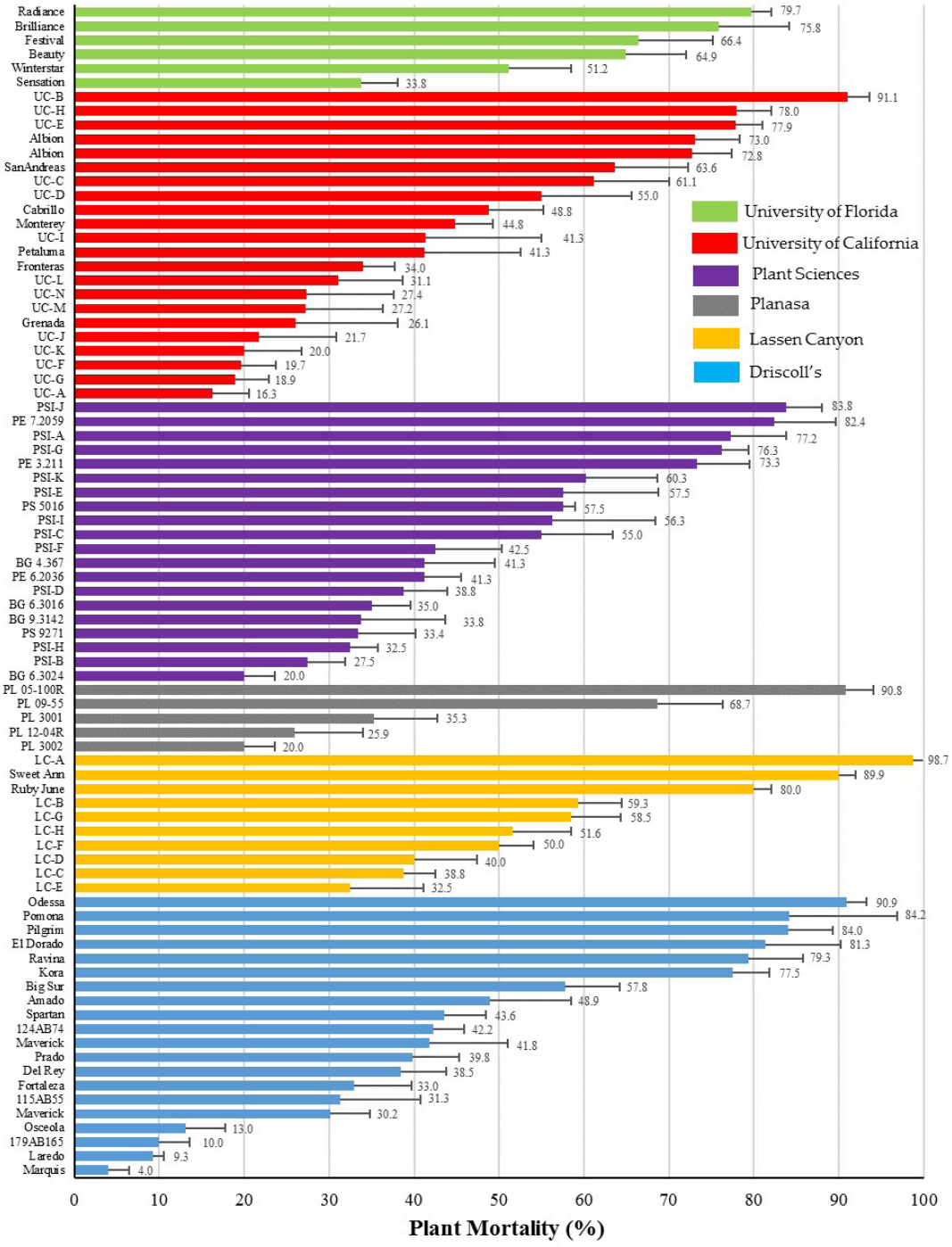

Figure 1. Average percent plant mortality due to Macrophomina crown rot as of August 2, 2019, sorted by breeding program. Cultivars are representative of public and private breeding programs. Error bars represent the standard error of the mean.

Discussion

In this experiment, all breeding programs had genotypes that are tolerant and susceptible to Macrophomina crown rot. Overall, disease levels were lower in this experiment (50.2%) compared to 2018's experiment (66.7%). This was true for all entries as well as the 24 cultivars common to both years. The plant response observed in this trial is consistent with other's findings (Zveibil et al., 2012), that is, disease due to *M. phaseolina* occurred late in the season and was exacerbated by high temperatures during the months of June and July. The cornmeal-sand inoculation method continues to provide consistent, but not overwhelming, disease pressure for field evaluation of host resistance to Macrophomina crown rot. This is the third year we have conducted this experiment. Each year, the genotypes and weather vary, providing the opportunity to observe a large number of genotypes under a variety of conditions. The results serve as both a guide to growers for managing Macrophomina crown rot, and to strawberry breeders in the development of new resistant cultivars.

Acknowledgements

We would like to acknowledge our collaborators at University California Davis, University of Florida, Driscoll's, Plant Sciences, Inc., Planasa, and Lassen Canyon Nursery for providing strawberry germplasm.

References

- Islam, M. S., M. S. Haque, M. M. Islam, E. M. Emdad, A. Halim, Q. M. Hossen, M. Hossain, M. Z. Ahmed, B. Rahim, M. S. Rahman, and M. M. Alam. 2012. Tools to kill: genome of one of the most destructive plant pathogenic fungi *Macrophomina phaseolina*. Bmc Genomics 13:493-509.
- Koike, S. T., R. S. Arias, C. S. Hogan, F. N. Martin, and T. R. Gordon. Status of *Macrophomina phaseolina* on strawberry in California and preliminary characterization of the pathogen. International Journal of Fruit Science 16:148-159.
- Mihail, J. D. 1992. Macrophomina. Methods for Research on Soilborne Phytopathogenic Fungi. L. S. Singleton, J. D. Mihail, and Rush, C. M. eds. American Phytopathological Society, St Paul, MN. Pages 134-136.
- Zveibil, A., N. Mor, N. Gnayem, and S. Freeman. 2012. Survival, host-pathogen interaction, and management of *Macrophomina phaseolina* on strawberry in Israel. Plant Disease 96:265-272.