Evaluating Strawberry Cultivars for Resistance to Verticillium Wilt, Field Ratings from 2019

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Summary

Soilborne diseases in strawberry are becoming increasingly important as the use of effective fumigants decreases. Our understanding and use of host resistance to control these diseases has lagged because of the reliance on fumigants. This situation can be remedied by a focus on breeding for resistance and a firm understanding of how strawberry cultivars will perform where high inoculum levels exist. We evaluated 83 strawberry cultivars for susceptibility to Verticillium wilt in field soil naturally infested with *Verticillium dahliae* over the course of the 2018-2019 season. Disease severity and plant mortality were assessed over time in both inoculated and non-inoculated plots. Genotypes varied widely in their response to the disease, from zero to 50% plant mortality, with an average mortality of 12.5% for all genotypes and 14.0% for 24 cultivars common to 2018 and 2019 experiments. This proposal directly addresses these high priority research areas for the central coast region: (1) farming without fumigants; (2) control of soilborne diseases; and (5) breeding for disease resistance.

Introduction

Host plant resistance is the most widely used and effective disease management strategy in all of agriculture. Preplant fumigation with methyl bromide and chloropicrin was so effective at controlling soilborne diseases of strawberries that it significantly reduced the practical importance of host plant resistance. With the phase-out of methyl bromide and rising concern over the use of all fumigants, the importance of host plant resistance is increasing dramatically. In order to effectively employ host plant resistance to manage soilborne diseases, growers need to know how current and future genotypes will perform in field soils naturally infested with soilborne pathogens. Resistance to Verticillium wilt has been a selection criterion in the UC breeding program for over twenty years and significant gains in basal levels of resistance within the UC breeding population have been achieved (Shaw et al., 2010). However, resistance has been quantified using root dip inoculations and it remains to be established how currently available cultivars will perform in the presence of natural soilborne inoculum (Gordon et al., 2012). Furthermore, in cultivar performance there are often significant year × genotype interactions, making it important to do evaluations at several locations and over multiple years. Previous studies at this site revealed that the field has high levels of soilborne *V. dahliae*. We have preserved this site for the purpose of evaluating control measures against Verticillium wilt. The objectives of this proposed research were to characterize commercial strawberry cultivars and elite breeding lines for their susceptibility to Verticillium wilt under field conditions in naturally infested field soil.

Materials and Methods

A replicated field trial was established to evaluate 83 cultivars and elite selections for resistance to Verticillium wilt caused by *V. dahliae*. 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. For the purpose of comparing year-to-year variation, there were 24 cultivars common between this year and last year.

On October 23, 2018, bare-root strawberry transplants were set in field 25, block 3 on the Cal Poly San Luis Obispo campus. This field had a history of Verticillium due to decades of vegetable cropping and was naturally infested with approximately 20 colony forming units of *V. dahliae* per gram of soil; strawberries had not been cultivated in this field until the fall of 2014. The trial consisted of 20-plant plots replicated four times, with a fifth control replicate planted in an area of the field that was fumigated with Ally 33 (67% AITC + 33% chloropicrin at 55 gal/A) in the fall of 2018. 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 dried up. 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 and NP-10 medium (Kabir et al., 2004).

Results

The first wilt symptoms due to infection by *V. dahliae* were observed in early April, roughly 170 days after planting. A wide range of susceptibility was observed among all genotypes and within each breeding program (Figures 1 and 2). The average mortality across all genotypes was 12.5%, compared to 24.9% in 2018 and 14.0% compared to 27.2% for the 24 cultivars common to 2019 and 2018, respectively. 'Odessa' (50.0%), 'Maverick' (31.6%) and 'BG.6.3016' (31.3%) were the most susceptible genotypes. 'LC-5' and 'UC-12' were the most tolerant genotypes to Verticillium wilt, with 0% mortality by August 2, 2019. The most resistant cultivars were 'Fortaleza' (3.8% mortality), 'Big Sur' (4.6%), 'Cabrillo' (5.0%) and 'Marquis' (5.0%).

Pathogen isolation from diseased plants revealed that in addition to *V. dahliae*, *M. phaseolina* was present and causing some disease in this experiment. However, *Macrophomina* should not be playing a significant role in causing plant mortality for the following reasons: 1) Macrophomina crown rot typically occurs later in the season than Verticillium wilt; 2) results for specific genotypes differ between the *V. dahliae*-infested field and the *M. phaseolina*-infested field (e.g., PL05-100R had 90.8% morality in the Macrophomina experiment, but only 4.1% mortality in the *Verticillium* experiment); and 3) results are consistent with similar experiments in previous years.

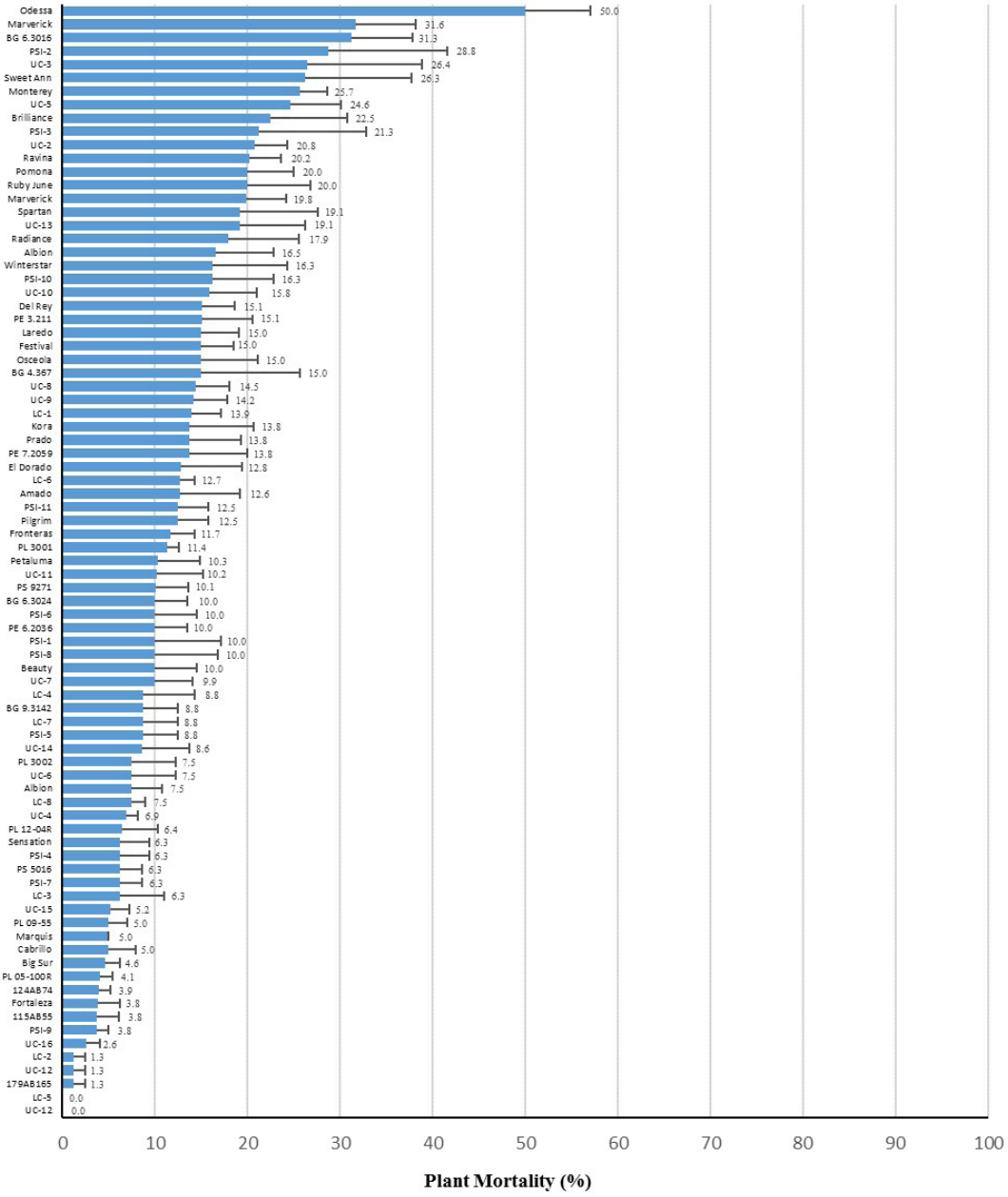

Figure 1. Average percent plant mortality due to Verticillium wilt as of August 2019. Error bars represent the standard error of the mean.

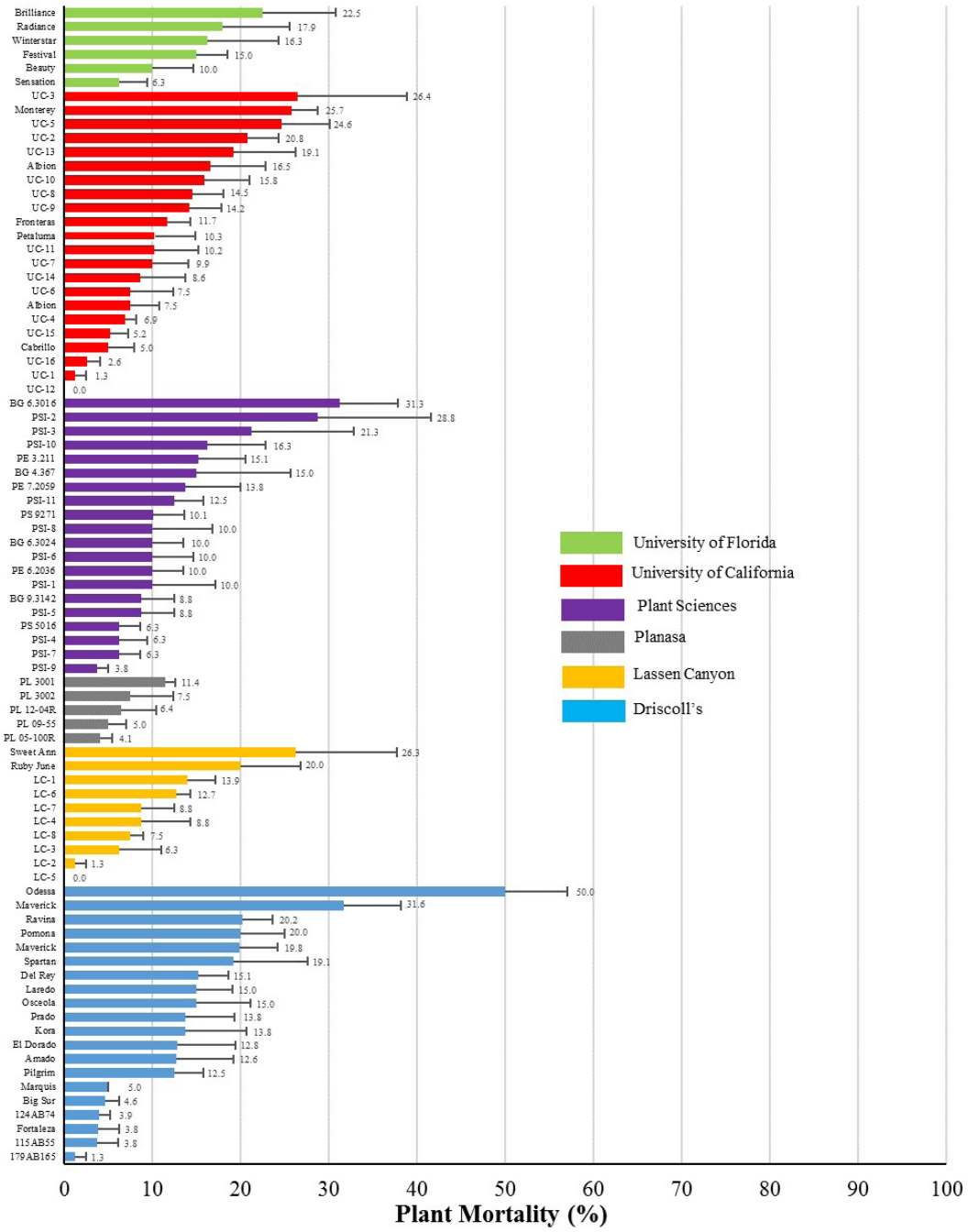

Figure 2. Average percent plant mortality due to Verticillium wilt as of August 2019, sorted by breeding program. Error bars represent the standard error of the mean.

Discussion

This is an excellent site for evaluating the susceptibility of strawberry germplasm to Verticillium wilt. The distribution of genotype susceptibility was continuous between zero and 50% plant mortality. All breeding programs have genotypes that are tolerant and susceptible germplasm to Verticillium wilt. These results can serve as both a guide to growers for managing Verticillium wilt, and for the development of new resistant cultivars for existing breeding programs. The presence of *M. phaseolina* at this site may lead us to use another block at Field 25 for this experiment.

Acknowledgments

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