Evaluating Strawberry Cultivars for Resistance to Verticillium Wilt

Co-Investigators
Dr. Gerald J. Holmes
Director, Strawberry Center
California Polytechnic State University, San Luis Obispo
gjholmes@calpoly.edu
Phone (805) 441-2274

Dr. Kelly Ivors
Associate Professor, Horticulture and Crop Science Department
California Polytechnic State University, San Luis Obispo
kivors@calpoly.edu
Phone (805) 756-6157

Ryan Brantley
Research Associate
California Polytechnic State University, San Luis Obispo
rbrantle@calpoly.edu
Phone (805) 441-3509

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 90 strawberry cultivars for susceptibility to Verticillium wilt in field soil naturally infested with *Verticillium dahliae* over the course of the 2016-2017 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 78% plant mortality. 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. Pre-plant 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 is often significant year × genotype interactions, making it important to do evaluations at several locations and over multiple years.

During the 2014-2015 season, a fumigation and strawberry cultivar performance study was conducted at Cal Poly. This study revealed that the field has high levels of soilborne *V. dahliae*. Cultivars 'Portola' and 'Monterey' were highly susceptible to the disease, while 'Albion' and 'San Andreas' were relatively resistant. 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 & Methods

A replicated field trial was conducted to evaluate 90 cultivars and elite selections for resistance to Verticillium wilt caused by *V. dahliae*. Strawberry germplasm was selected from six public and private breeding programs. On October 18, 2016, 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 approximatley 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 350 lb/A methyl bromide (MB) (50%) + chloropicrin (50%) in the fall of 2014. Disease incidence was determined by counting the number of dead plants ("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 July 18, 2017. 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 March, roughly 140 days after planting. Of the cultivars tested, a wide range of susceptibility was observed (Figure 1). Proprietary varieties were the most susceptible genotypes, with more than 75% mortality by July 18, 2017. Several UC selections ('UC-7', 'UC-6', 'UC-8', 'UC-12', 'UC-22') and cultivar 'Camino Real' were the most tolerant genotypes to Verticillium wilt, with less than 3.5% mortality by July 18, 2017. The cultivar 'Radiance' was not included in the dataset, since *Phytophthora cactorum* was consistently isolated from several symptomatic plants in early February.

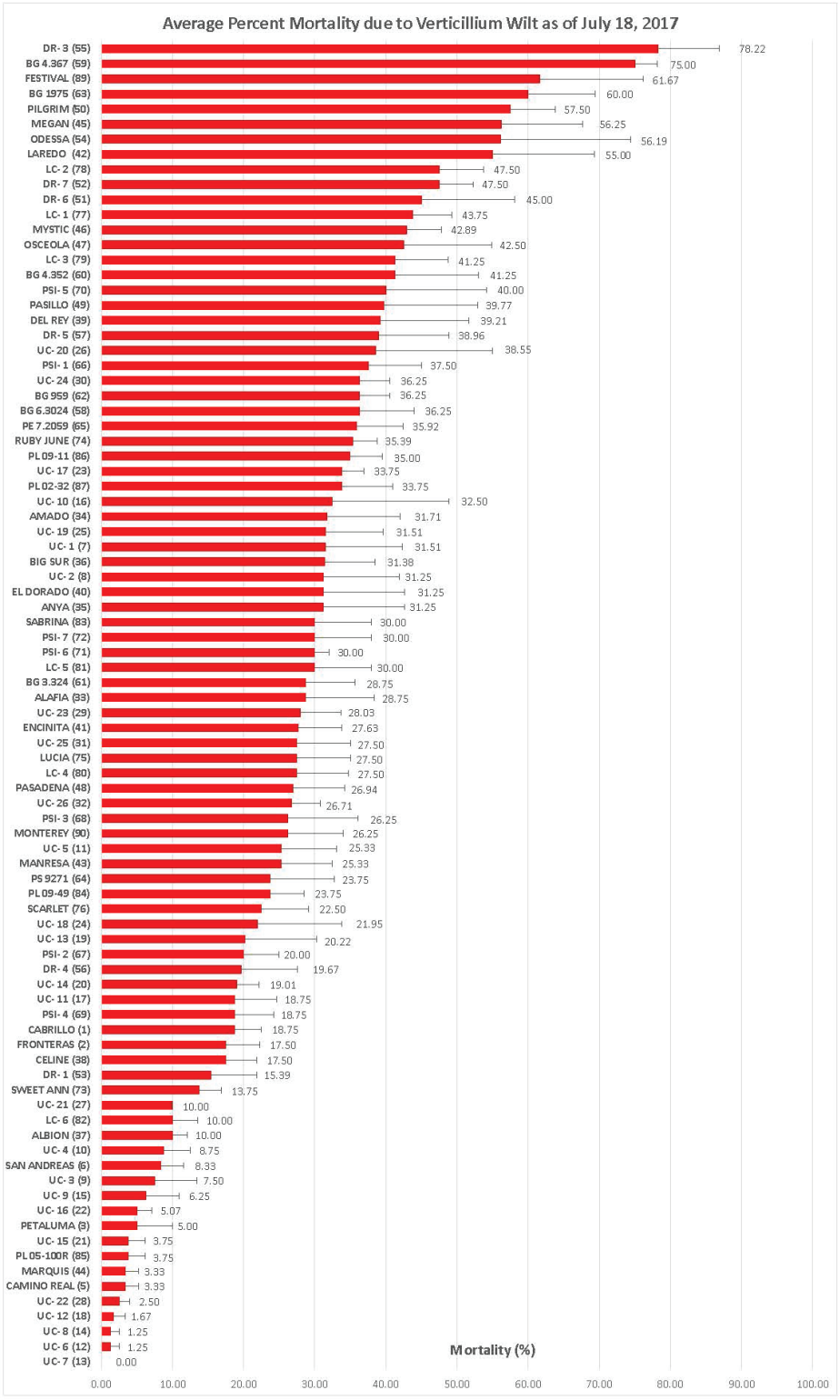

Figure 1. Average percent plant mortality due to Verticillium wilt as of July 2017. Error bars represent the standard error of the mean. Statistical differences by pairwise comparisons are not shown.

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 78% plant mortality. All breeding programs contained both tolerant and susceptible germplasm to Verticillium wilt. This data can serve as both a guide to growers for managing Verticillium wilt, and for the development of new resistant cultivars for existing breeding programs.

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