Investigating Soil-Borne Diseases of Pistachio in California

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INTRODUCTION

In recent years, we detected various declines of pistachio trees caused by soil-borne pathogens. Declining trees were usually characterized by chlorotic foliage as well as wilting, defoliation and eventual tree death. Trunks often expressed gumming together with crown rot symptoms. Investigations of the causes of tree decline in pistachio revealed the occurrence of several *Phytophthora* species including *P. niederhauserii*, *P. cinnamomi* and *P.* taxon walnut associated with crown or root rots. The fungus *Macrophomina phaseolina* was also commonly isolated from both young declining pistachio trees and rootstocks expressing root and crown rot symptoms. Species of *Fusarium oxysporum*, *F. solani* and *F. proliferatum* were also detected, on occasion, from unusual crown rot symptoms. To date, little is known about soil-borne pathogens affecting pistachio in California. Therefore, the objectives of this study were to characterize the newly discovered soil-borne pathogens, investigate their pathogenicity and evaluate commercially available pistachio rootstocks for disease tolerance. In 2017, several pathogenicity and rootstock susceptibility studies were conducted at the Kearney Agricultural Research and Extension Center (KARE) using clonal UCB-1, PGI and/or PGII (Platinum) rootstocks.

RESULTS

Results of pathogenicity studies showed that *Phytophthora niederhauserii*, *P. cinnamomi, P.* taxon walnut and *M. phaseolina* can cause root and crown rots in both UCB-1 clonal and PGII (Platinum) rootstocks. Inoculation of young potted plants, with *Phytophthora* spp.*,* resulted in complete wilting and death of plants three weeks after inoculation. *Phytophthora* species were re-isolated from root and crown rot symptoms, thus completing Koch's postulates. In one experiment, PGII (Platinum) rootstocks appeared more tolerant to *Phytophthora* pathogens than clonal UCB-1 rootstocks, however these findings were not reproduced in a second experiment where both rootstocks were affected similarly by these pathogens. *Phytophthora* species affecting pistachio trees, in California, have been poorly investigated, overall, until the present study. This study is the first to report *Phytophthora niederhauserii*, *P. cinnamomic* and *P.* taxon walnut causing root and crown rots in pistachio in California. *P. niederhauserii* and *P. cinnamomi* causing crown rots were recently reported as emerging pathogens of almond in California. Recently, *P.* taxon walnut has been shown to be pathogenic on nonwoody stems of *P. vera* in California.

Macrophomina phaseolina affected both UCB-1 clonal and PGII (Platinum) rootstocks equally, resulting in the killing of all inoculated plants. The occurrence of *M. phaseolina* in pistachio, in California, has not been reported prior to the present study. This year, additional cases of declining pistachio trees associated with *M. phaseolina* were detected. *M. phaseolina* has been known as the causal agent of Charcoal rot of many field crops, including corn, cotton, sunflower, potato and sorghum. In California, charcoal rot appears to be the most important current concern for the strawberry industry due to its steady increase over the past 10 years. The

fungus is known to produce microsclerotia, whose production increases under low-water potentials that occur during drought. Despite little reports of *M. phaseolina* affecting perennial woody crops, we have isolated it also from declining table grapes and sweet cherry trees in California.

Fusarium solani and *F. proliferatum* appeared to diminish the growth of pistachio plants, following soil inoculations, but did not cause wilting or death of plants. In the fruit and nut crops, *Fusarium* species often have been regarded as secondary invaders of diseased tissues, and generally have received little interest for biological studies. This work is one of the first to investigate the taxonomy and biology of *Fusarium* species in pistachio. Isolates of *F. solani*, *F. oxysporum*, and *F. proliferatum* appeared to cause rot symptoms in stems of UCB-1 rootstocks. These fungi also appeared to affect the growth of rootstock plants. More studies are ongoing to fully understand the role of *Fusarium* species in pistachio, but a recent study in Tunisia showed that *Fusarium solani* can cause root rot of pistachio. The same fungus also can cause dry root rot of citrus in California, causing crown rot and girdling of the trunk base of citrus trees. *Fusarium oxysporum* is generally associated with vascular wilt and root diseases on a wide range of plants.

Another experiment was established at KARE, in the fall of 2017, to compare the susceptibility of the main pistachio rootstocks, including UCB-1, PGI and PGII (Platinum), to all the various soil-borne pathogens isolated during this study. This experiment is ongoing and aims to identify most tolerant rootstocks to improve management of soil-borne diseases. Last fall, 144 plants of each of UCB-1, PGI and PGII (Platinum) rootstocks were inoculated using 2-3 isolates of all species under investigation.

CONCLUSION AND APPLICATION

Phytophthora species, including *P.niederhauserii*, *P. cinnamomi* and *P.* taxon walnut, were isolated from diseased pistachio trees in commercial orchards, and all species were shown to cause root and crown rot diseases in pistachio.

Macrophomina phaseolina has been found repeatedly from declining pistachio trees and was generally associated with root and crown rots. The pathogenicity of this fungus was confirmed.

Fusarium oxysporum, *F. solani* and *F. proliferatum* also are found associated with pistachio crown and root rots. The biology of these fungi is still under investigation, but preliminary findings suggest they are pathogens of pistachio.

Experiments are ongoing to identify the most tolerant rootstocks, in order to improve management of soil-borne diseases.