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Avocado Branch Canker (Formerly Dothiorella Canker)

Introduction

California accounts for the majority of U.S. avocado production, followed by Florida and Hawaii. The California avocado industry presently extends over 64,000 acres and produced an annual crop valued at over \$199 million in 2009 (1). Members of the fungal family *Botryosphaeriaceae* are known to cause branch cankers on a variety of woody hosts, including avocado, on which the disease came to be known as Dothiorella canker because the pathogen most often isolated at the time was known as *Dothiorella gregaria* (teleomorph *Botryosphaeria ribis*) (4). *Botryosphaeriaceae* spores enter and initiate infection primarily through pruning wounds on the trunk or branches. Symptoms observed on avocado trees with Dothiorella canker include shoot blight and dieback, leaf scorch, branch cankers and stem-end rot of fruit (Fig.1-4). More frequent pruning, such as

would occur in a high density grove, could increase the transmission rate of this pathogen from tree to tree, leading to an increase in canker development and a possible decrease in yield as branches with cankers are pruned out. Identifying and characterizing the primary causal agents of this disease will assist in applying the appropriate control measures to reduce yield loss.

Fig: 1. Dothiorella branch dieback symptom on avocado.



Fig: 2. Dothiorella canker symptom on avocado branch.



Fig: 3. Dothiorella stem-end rot symptom of fruit



Fig: 4. Leaf scorch caused by Dothiorella pathogens on avocado.



Background

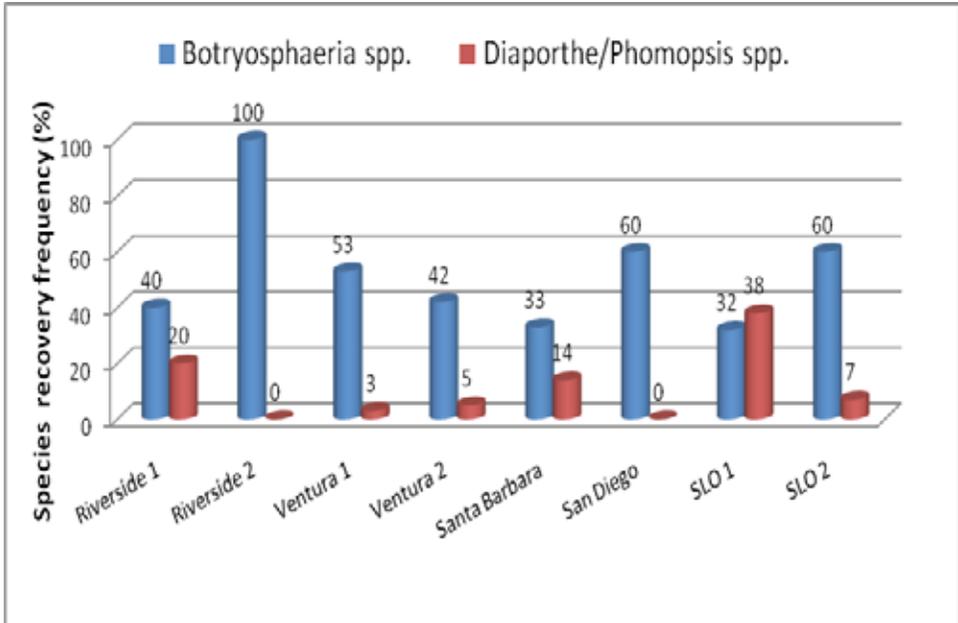
In 1934, Horne and Palmer were able to isolate the fungus *Dothiorella* from avocado branch cankers and dead twigs, but did not have success in proving its pathogenicity by inoculating pieces of canker into healthy twigs (5). At that time it was primarily known as *Dothiorella* rot of avocado fruit, and cankers produced by *Dothiorella* on branches or trunk seemed of minor importance. In 1953, Halma and Zentmyer noted that trunk cankers on California avocado trees were especially severe on Guatemalan rootstocks and scions and *Dothiorella gregaria* was readily isolated from these cankers (4). Taxonomic revisions have since reclassified this fungus as *Fusicoccum aesculi* (teleomorph *Botryosphaeria dothidea*) (10). *B. dothidea* was the only reported *Botryosphaeria* species causing *Dothiorella* branch canker on avocado in California until our research showed that there are at least three additional *Botryosphaeriaceae* species that are involved (8).

Current Research

In 2008-2010, eight avocado groves in five California counties were surveyed by sampling branch cankers from five symptomatic trees per grove. Canker specimens were evaluated in the lab and the percent recovery of *Botryosphaeriaceae* fungi based on morphology ranged from 40-100% in Riverside County, 42-53% in Ventura County, 33% in Santa Barbara County, 60% in San Diego County and 32-60% in San Luis Obispo County (Fig. 5). Three species of the *Diaporthe/Phomopsis* genera were also isolated from six out of the eight groves sampled, although generally to a lesser extent than the *Botryosphaeriaceae* fungi.

Molecular methods were used to identify the *Botryosphaeriaceae* fungi to the species level. Species identified, based on revised nomenclature (3, 12), include *Neofusicoccum australe*, *N. luteum*, *N. parvum*, *N. ribis*, *N. vitifusiforme*, *B. dothidea*, *Dothiorella iberica*, *Lasiodiplodia theobromae* and *Diplodia mutila*. The three *Diaporthe/Phomopsis* species recovered from canker tissue were

Fig. 5. Pathogen recovery frequency (%) from avocado branch cankers from eight groves in five California counties, 2008-2010.

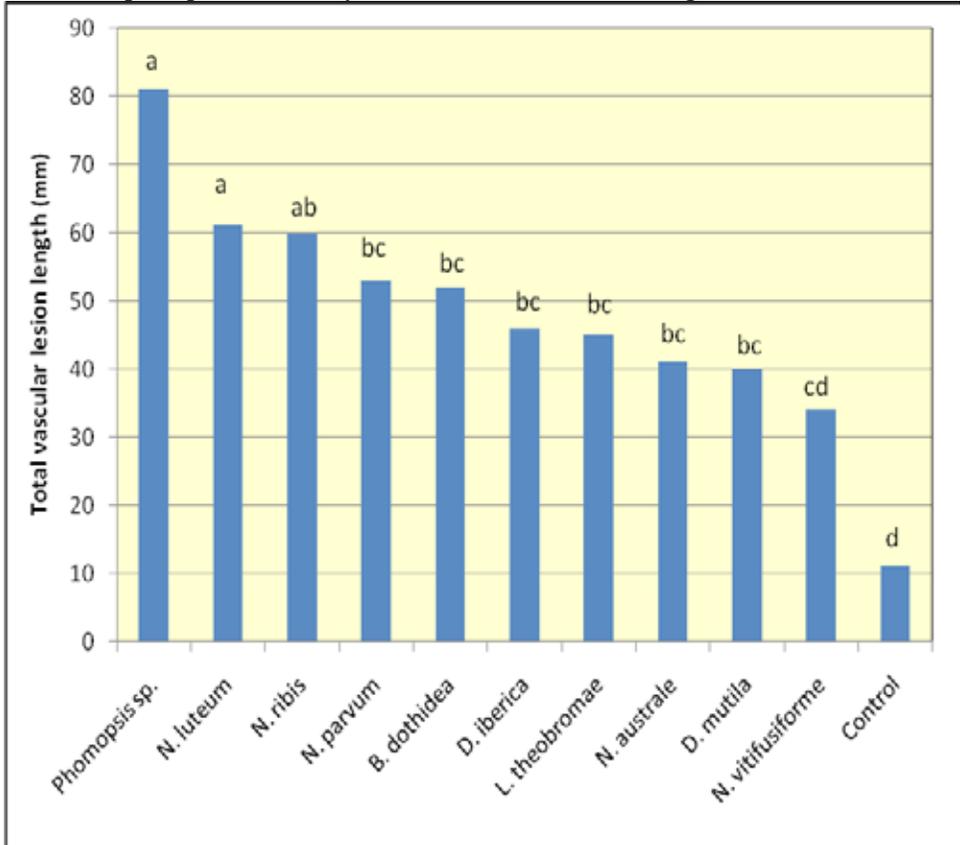


SLO = San Luis Obispo

identified as *Phomopsis theicola*, *P. viticola* and *Diaporthe phaseolorum*. The symptoms caused by all these fungi are similar and include the symptoms noted above (Fig. 1-4).

Pathogenicity tests were conducted in the greenhouse with nine *Botryosphaeriaceae* species and one *Phomopsis* species. One-year-old avocado seedlings, cv. Hass, were inoculated with each of the *Botryosphaeriaceae* and *Phomopsis* species, with ten replicate seedlings per fungal species. Seedlings were stem-wound inoculated with a mycelial plug and covered with parafilm. Sterile PDA plugs were applied to seedlings as a control. Over a period of three to six months, seedlings were assessed for disease symptoms which included browning of leaf edges and shoot dieback. Preliminary data analysis of the mean vascular lesion lengths with the *Phomopsis* species and eight of the nine *Botryosphaeriaceae* species shows a significant difference with the control (Fig. 6).

Fig. 6. Mean vascular lesion lengths of nine different *Botryosphaeriaceae* species and one *Phomopsis* species on one-year-old Hass avocado seedlings, 2009.^{abc}



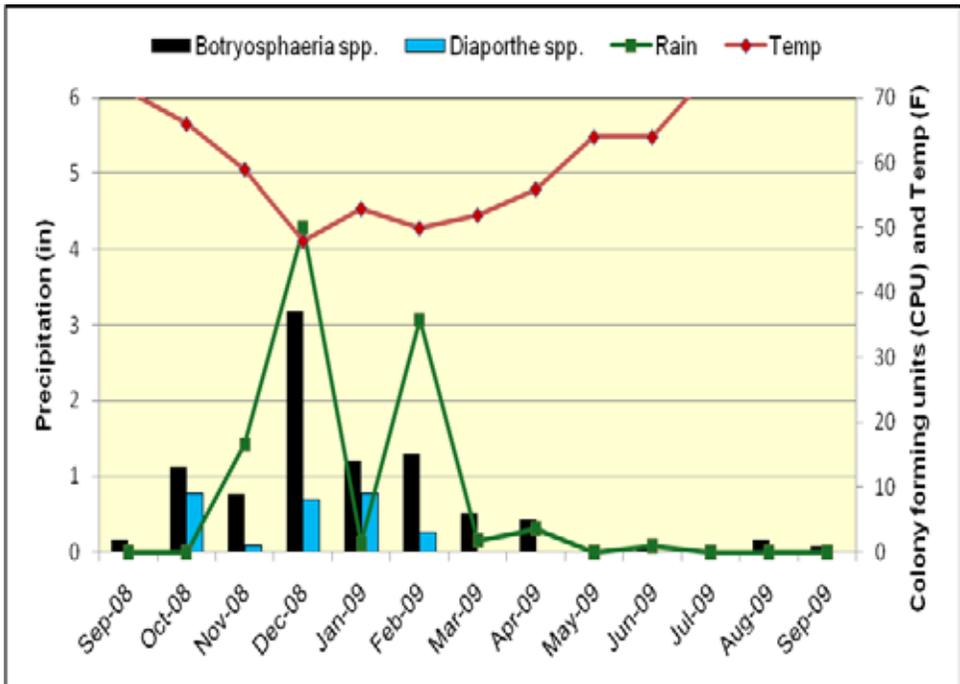
^aEach bar represents the mean of 10 avocado seedlings. Means with the same letter are not significantly different at the 0.05 level. ^b*L. theobromae* = *Lasiodiplodia theobromae*. ^c*D. mutila* = *Diplodia mutila*

Spore traps were placed onto each sampled tree and changed every two to four weeks for one year. The spore trap study was to assess the type of air-borne spores that were present in the grove that could possibly initiate infection on any open branch or trunk wound. Spores of *Botryosphaeriaceae* species are known to enter the host plant through wounds such as pruning wounds, split branches from wind damage, frost damage, mechanical and grafting wounds (9). Infection is more likely if the tree is already stressed from drought, flooding, insect attack, nutrient deficiencies or any other factor which weakens the tree. Ascospores from perithecia (the sexual fruiting

bodies) are produced during the winter and spring and are wind-disseminated. Conidia from pycnidia (the asexual fruiting bodies) are produced year round and are usually disseminated by precipitation (9). Both types of fruiting bodies can be found on dead bark, twigs and branches and both are infective (9).

High-density planting is becoming more common in California and other avocado production areas of the world. High-density planting necessitates more frequent pruning to manage tree growth. Since *Botryosphaeriaceae* species are wound pathogens, more frequent pruning could increase the transmission rate of this pathogen from tree to tree leading to an increase in branch cankers if pruning wounds are not treated properly. Our spore-trapping studies show that *Botryosphaeriaceae* spores are trapped throughout most of the year within California avocado groves, with a sudden increase in spores trapped soon after or coinciding with a rain event (Fig 7). This is consistent with findings from other woody hosts, such as grapevine (11).

Fig. 7. Air-borne spores trapped in a San Diego County avocado grove, Sep. 2008-Sep. 2009.



There are currently no effective control strategies for avocado branch canker. The chemical treatment of any open wounds on the tree would be the primary means of protecting against *Botryosphaeriaceae* or *Diaporthe/Phomopsis* spores entering and initiating infection. No current literature was found which evaluates the chemical treatment of pruning wounds for avocado; however, there is literature on other hosts such as apple (2), oak (7) and apricot (6). In 2010, 15 chemicals were screened in our lab on *Botryosphaeriaceae* and *Diaporthe/Phomopsis* fungal species that had been isolated from avocado branch cankers in the above study. Of these, approximately 8 individual plus 2 or 3 combinations of chemicals will be further tested in field trials beginning in fall 2010.

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