Mucor foliar spot and mycoflora in stem and root lesions of peach[1]

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ABSTRACT

Fungi associated with root rot, stem canker, dieback, gummosis and leaf spots in young peach trees were isolated and identified. The most predominant fungi in the stem and root lesions were *Fusarium solani* and *F. oxysporum*. *Dothiorella* sp. was associated with the stem gummosis, and *Mucor hiemalis* was consistently found in the leaf lesions. Pathogenicity tests confirmed *M. hiemalis* as the cause of the foliar spots in peaches.

Key words: *Prunus persica*, *Mucor hiemalis*, leaf spot, gummosis, canker, root rot, dieback, Puerto Rico

RESUMEN

Mancha foliar de Mucor y micoflora en las lesiones de tallos y raíces del melocotón

Hongos asociados a pudrición de las raíces, cancros en los tallos, muerte regresiva, gomosis y manchas en las hojas de árboles jóvenes de melocotón fueron aislados e identificados. *Fusarium solani* y *F. oxysporum* fueron los hongos más predominantes en las lesiones de los tallos y raíces. *Dothiorella* sp. se encontró asociado con la gomosis del tallo y *Mucor hiemalis* se encontró consistentemente en las manchas de las hojas. Las pruebas de patogenicidad confirmaron a *M. hiemalis* como el hongo causante de las manchas en las hojas de los melocotones.

Palabras clave: *Prunus persica*, *Mucor hiemalis*, mancha foliar, gomosis, cancros, pudrición de raíz, muerte regresiva

INTRODUCTION

Peach [*Prunus persica* (L.) Batsch] cultivars UFGold, Florida Prince, Tropical Beauty and UF Glo were introduced to Puerto Rico as part of a cooperative research project with The University of Florida. At arrival, roots showed canker lesions and overall profuse growth of fungi. Since the identity of the associated fungal flora was unknown, as a preventive phytosanitary measure, it was recommended that the roots be washed, pruned, and scrubbed with a commercial chlorinated

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detergent and immersed in any broad-spectrum fungicide. Because of complications with the application of the whole treatment, roots were instead washed, pruned and immersed in a solution of metalaxyl according to the label recommendations. After treatment, plants were planted in containers filled with commercial peat moss and placed in the greenhouse at the Adjuntas Experiment Station for a two-month quarantine period.

In the greenhouse, several plants of all cultivars showed cankers in the nodes and internodes as well as branch dieback. Internal tissues of these symptomatic stems showed cortical necrosis typical of canker diseases. Necrotic streaks in tissues below the canker and below the leading edge of the dieback suggested some vascular invasion. Gummosis in the stem base and circular foliar spots with concentric rings, darker round center and water-soaked borders were observed in cv. UF-Gold. The plant showing symptom of gummosis was destroyed in the autoclave. Because of the symptoms shown in the peach trees it was considered essential to identify the associated mycoflora and to determine their pathogenicity.

MATERIALS AND METHODS

Samples from all organs showing fungal growth and symptoms were brought to the laboratory for processing according to the standard protocols for pathogen isolation. Portions of the external mycelia from roots and propagules obtained from tissues incubated in humid chambers at 27° C, were transferred directly to potato dextrose agar (PDA). Most sporulating isolates were purified as monosporic cultures and their identification was corroborated by the Fusarium Research Center at The Pennsylvania State University or by the Commonwealth Mycological Institute in England.

Peach plants were appointed for the planned field experiment; therefore it was difficult to obtain the appropriate population of plants for testing the species isolated from the roots and stem lesions. Pathogenicity tests were conducted in vitro only with the fungus isolated from the leaf spots. For these tests, asymptomatic leaves were collected from plants in the greenhouse and disinfested by being washed with soap, rinsed in running tap water, immersed for 1 min in a 10% solution of a commercial chlorinated detergent, and rinsed in sterile distilled water. Leaves were placed over glass slides in a sterile humid chamber consisting of Petri plates and humid filter paper. Using a 3-mm diameter cork borer, plugs were cut from the growing edge of the fungal colony developed in PDA. The inoculum was placed in contact with the upper and under side of the leaf, at three sites, with and without wounding. Each inoculation combination and controls (leaves treated with plugs of PDA only) were repeated three times. The pathogenicity tests were conducted twice. In the first, leaves from cv. UFGold were used; in the second, cvs. UFGold, Florida Prince and Tropical Beauty were tested. Koch's postulates were followed and in all cases the inoculated fungus was isolated from the infected tissues.

RESULTS AND DISCUSSION

Fusarium solani and *F. oxysporum* were found associated with most of the symptoms studied (Table 1). *Rhizoctonia* sp. was isolated from the stem canker. *Dothiorella* sp. and *Pestalotia* sp. were colonizing the stem tissues showing gummosis, and *Trichoderma* sp. was primarily associated with the external mycelium observed in the roots.

Mucor hiemalis Wehmer proved to be pathogenic to the leaves and is the cause of the observed leaf spots. Lesions began as water-soaked areas that gradually expanded with pathogen colonization (Figure 1). Seven days after inoculation, severe necrosis and destruction of leaf tissues occurred. Disease development was faster and severity high when wounded tissues were inoculated on the lower side of the leaves; however, side of the leaf and wounding did not preclude pathogenicity. Standardization of inoculum was not possible; detachment of the plugs was difficult because of the sticky surface of the colony. Consequently, the size of the plugs was not uniform, affecting the leaf area inoculated.

TABLE 1. *Fungal flora associated with symptoms in young peach trees.*

Symptom	Isolate
External myceliumin the roots	*Trichoderma* sp. *Fusarium solani* *Fusarium oxysporum*
Root rot	*Fusarium solani* *Fusarium oxysporum*
Stem canker	*Fusarium solani* *Fusarium oxysporum* *Rhizoctonia* sp.
Gummosis	*Fusarium solani* *Dothiorella* sp. *Pestalotia* sp.
Dieback	*Fusarium solani* *Fusarium oxysporum* *Cladosporium* sp.
Leaf spot	*Mucor hiemalis*

FIGURE 1. Leaf spot caused by *Mucor hiemalis* on the adaxial surface of peach cv. UFGold seven days after inoculation with (ww) and without wounds (nw).

This variation in the inoculum potential influenced the success of the inoculation within the same leaf and inoculation combination. All cultivars tested were susceptible, but differences in susceptibility could not be determined.

Except for the leaf spots, the role of the other fungi found in association with the lesions could not be established by traditional methods. Most of the species identified are proven pathogens causing similar symptoms in other fruit crops or in peaches elsewhere. The fusaria found are ubiquitous soil-borne fungi well known for their variation and pathogenicity to the roots of most cultivated plants. Along with other organisms, *Fusarium* spp. have been associated with the biotic causes of the peach replant disorder (Larsen, 1999). *Trichoderma* sp. is considered primarily a soil-borne saprobe, and its role in the peach roots should be considered saprophytic.

Several species of *Dothiorella* have been reported as causing gummosis in citrus (Menge, 1988), stem cankers and fruit rots in avocado, and dieback and fruit stem-end rot in mango (Johnson, 1994). Most species have as teleomorph *Botryosphaeria dothidea* that has been reported as the cause of fungal gummosis in peaches (Pusey et al., 1999). Since 1911, *B. dothidea* has been reported in Puerto Rico, but in dead wood (Stevenson, 1975).

Mucor hiemalis is a cosmopolitan soil-borne fungus (Farr et al., 1989) and has been isolated from the soil in Puerto Rico (Stevenson, 1975). Although usually considered a soil saprobe, as a pathogen it has been responsible for rots in fresh produce (Nagar and Chauhan, 1977; Kunimoto et al., 1977). It is considered seed-borne in sesame (Sulochana and Balakrishnan, 1997), and for disease management several products have proved effective in reducing disease levels (Washington et al., 1999). A Mucor rot caused by *Mucor* spp. and *M. piriformis* have been reported in ripe peaches (Ogawa, 1999). This is the first report of *Mucor hiemalis* causing leaf spot in peaches and as a new pathogen in Puerto Rico.

Knowledge of the spectrum of pathogens that can cause diseases in any crop is very important for successful crop management. In particular it is critical for novel enterprises with non-native species. Plant introductions may prove susceptible to the pathogen flora established in a location or, because of the variation of pathogens and their host range, could bring forms affecting other existing important species. The fungal species found have been reported in Puerto Rico. However, close monitoring of the peach trees planted in the field proceeded for identification of forms, if any, with variations in virulence and host range, as well as for the appearance of new diseases.

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