

Biology and Management of Septoria Spot of Citrus

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Septoria spot of citrus caused by *Septoria citri* is found in many citrus-producing countries around the world. It is a sporadic disease in California with most reports coming from Tulare Co. and Fresno Co. The pathogen is present on leaves and twigs in many orchards, and fruit infections probably occur commonly. Disease from these quiescent infections, however, only develops when plant tissues become senescent or environmental conditions predispose the host to infection.

First reported in the 1940s, recent outbreaks (2003-04 and 2004-05 seasons) have caused trade restrictions for California oranges in the Korean market. The risk of rejecting California citrus fruit in international markets required that: (1) rapid detection methods be developed for the pathogen for correctly diagnosing the disease; (2) conditions for fungal infection be studied; (3) management practices be revised, and (4) that a fruit incubation program be developed.

Early symptoms of Septoria spot consist of small lesions and depressions or pits that extend no deeper than the albedo. Lesions may coalesce into larger sunken blotches, and pycnidia develop that produce masses of asexual, filiform conidia. Because early symptoms are not unambiguously diagnosed, we initiated molecular studies on the detection. Published PCR amplification primers were found not to be highly specific. Thus, from our own DNA sequences, new primers are being developed and evaluated for the detection of Septoria spot.

In laboratory inoculation studies, a high incidence of disease was only obtained after wounding of orange fruit and using a spore suspension containing cycloheximide (a compound that promotes tissue senescence). In addition, incubation for 24 hours at -3° C before or after inoculation that was followed by incubation at 30° C significantly increased disease incidence and severity. Still, fruit had to be incubated for 4-6 weeks for symptoms to develop. These incubation conditions are in agreement with our field observations on disease occurrence.

Thus, in the 2004-05 season, Septoria spot was first detected in the field in Fresno and Tulare counties in January 2005. High rainfall had occurred in October/November 2004, 5-6 consecutive days with temperatures below 0° C for more than 9 hours occurred in late November to early December, and rainfall continued at most locations. Thus, high rainfall created conducive conditions for growth and dissemination of *S. citri*, and temperatures below 0° C caused injuries to the host that allowed infection of the pathogen and development of Septoria spot. Evaluation of epidemiological data is ongoing with the goal to predict infection periods and to optimize timing of fungicide applications in the field.

In management studies, the in vitro toxicity of fungicides against *S. citri* was evaluated. EC₅₀ values for mycelial growth of 0.01, 0.1, 0.25, 0.45, and >10 ppm were obtained for azoxystrobin, imazalil, TBZ, fludioxonil, and pyrimethanil, respectively. Field trials for preharvest fungicide programs were established. No symptoms of Septoria spot, however, occurred at these orchard sites. (Thus, in 2005-06 trials are being conducted at sites where the disease was present in the

previous season.) In another orchard where symptoms of Septoria developed on some fruit, two preharvest treatments with Abound numerically but not significantly reduced the natural incidence of disease from 40.7% to 31%. In laboratory fruit inoculation studies, postharvest treatments with Scholar, Freshgard, Abound, or TBZ significantly reduced the incidence of disease when treatments were done 16-24 hours after wound-inoculation.

In experimental packingline studies, however, drench treatments with ambient-temperature or heated fungicide (TBZ, Freshgard, or Abound) solutions gave inconsistent results. Using symptomless, naturally infected fruit, there was only a moderate reduction in incidence of Septoria spot after treatments with Freshgard, TBZ, Orbit, or Abound. Additionally, TBZ drenches or high-pressure washes with sodium bicarbonate and chlorine, followed by a heated (118 F°) imazalil treatment reduced disease incidence from 11.5% in the control to 8.8%. In trials at commercial packinghouses, only treatments that contained TBZ (4000 ppm) and imazalil (1700 ppm) in the pack wax consistently reduced the incidence of Septoria spot. Still, these data indicate that preharvest treatments with Abound and postharvest fungicide treatments are only moderately effective for management of Septoria spot and cannot be used by themselves to guarantee control of the disease in shipments of fruit to international markets where Septoria spot is a quarantine disease.

In cooperation with the California Citrus Quality Council (CCQC), the California Citrus Incubation Program (CCIP) for the Detection of Septoria Spot was established as part of the California Citrus for Export to Korea Program. This program was conducted at the UC Kearney Agricultural Center and certified fruit exported to Korea from Fresno and Tulare Co. This was to ensure against rejections of fruit in Korea by detecting the disease before shipments are sent. (In the 2005-06 season, the program is being continued as the Navel and Valencia Export to Korea (NAVEK) program.) In addition, guidelines were developed and training sessions for growers, packers, and shippers were conducted.

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