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DISEASE NOTES

First Report of *Pseudomonas syringae* pv. *syringae* Causing Bacterial Blister Bark on Apple in Norway

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In some commercial orchards in southern Norway, apple trees (*Malus domestica*) developed abnormally in spring 2015. The majority of trees affected were of cv. Discovery. It was an unusually cold and wet spring, and many buds did not break or tissue that grew from buds became blighted, typically within 2 to 3 weeks. The trees exhibited twig lesions with papery brownish blisters forming in the outer bark around buds, on branches or as lesions on the main trunk. The symptoms resembled that of bacterial blister bark caused by *Pseudomonas syringae*. Later in the season leaf spots, all resembling typical infections by *P. syringae*, appeared in the orchards with blister bark symptoms. Similar symptoms caused by *P. syringae* have been observed in apple trees in South Africa (Mansvelt and Hattingh 1986) and Italy (Scortichini and Morone 1997), causing significant damage. Samples from three orchards in different fruit growing areas in southern Norway were collected, and bacteria were isolated. Twig samples were washed under running tap water and left to dry on paper towels. The flaky epidermis was removed aseptically, and small pieces of tissue underneath were excised from the margins between healthy and diseased tissue. The pieces were soaked in 0.4 ml sterile phosphate buffer saline (SPBS) for 30 min. Suspensions were streaked on nutrient glucose agar (NGA) medium, and plates were incubated at room temperature. After 48 h, dominating white-gray, round colonies with entire margins were picked and restreaked for purification. Twelve isolates were identified as *P. syringae* pv. *syringae* by fatty acid analysis (Sasser 1990), and two of these isolates, from blister bark symptomatic tissue from Norwegian orchards in 2015, were further analyzed by PCR with primers specific for the different phylogroups of *P. syringae* (Borschinger et al. 2016). Both of the isolates from bacterial blister bark symptoms belonged to *P. syringae* phylogroup 1. In April 2016, 1-year-old trees of cv. Discovery grafted on rootstock M9 were inoculated with three different strains of *P. syringae*. The

trees were injured with longitudinal cuts of 2 to 3 cm in the bark. Autoclaved cotton balls were soaked with bacterial suspensions of 10^8 cells/ml and attached to the wounds with Parafilm. The isolates were inoculated on four trees each, and an additional two trees were treated with SPBS instead of a bacterial suspension as a negative control. The cotton was removed after 48 h. The trees were then grown in a ventilated high plastic tunnel. After 12 weeks, symptoms resembling bacterial blister bark or canker symptoms had developed on all inoculated trees. Control trees did not develop symptoms. Reisolations were performed from symptomatic tissues, and isolates were identified by fatty acid analysis as *P. syringae* pv. *syringae*. We have demonstrated for the first time that *P. syringae* pv. *syringae* causes bacterial blister bark of apple in Norway. Cold springs and frost damage are known to predispose apple trees to infection with *P. syringae* (Kennelly et al. 2007), and the severity of the disease observed in 2015 may have been due to unusually cold and wet conditions during spring that year.

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