

Bacterial leaf spot of tomato and pepper

What is bacterial leaf spot?

Bacterial leaf spot (BLS) is caused by several species of *Xanthomonas*: *X. vesicatoria*, *X. euvesicatoria*, *X. perforans* and *X. gardneri*. In Australia, three of these species are known to occur. *X. euvesicatoria* infects mainly capsicum and chilli, while *X. vesicatoria* and *X. perforans* primarily infect tomato. The fourth species, *X. gardneri* was not detected in recent surveys of Australian crops and is thus not known to occur here. Yield loss is generally a result of decreased photosynthetic area, though in severe infections direct fruit damage is also seen.

What does it look like?

BLS symptoms may occur at any point during plant development. Small (>1mm) tan to black lesions grow to about 2-3 mm in diameter, often with an angular appearance. These spots may coalesce to form large necrotic sections of leaf. Spot may appear on leaves, stems, and calyx. Fruit spots are less common but present in severe infections, and may appear in a variety of sizes. Severe infections can result in entire plant death and can move through a field rapidly. Wilt and rot symptoms are not associated with this disease.



Angular dark spots on leaves, stem and calyx. Yellow halo around the spot may be suggestive of bacterial disease though is not definitive, diagnostic testing is required for confirmation.

What can it be confused with?

BLS presents as a leaf spot, which can be easily confused with other bacterial or fungal spots. In particular, bacterial speck lesions (*Pseudomonas syringae* pv. *tomato*) and fungal spots (e.g target spot caused by *Alternaria solani*) on tomato can appear almost identical to BLS. Speck is generally characterised by smaller spots that give the leaf a 'peppered' appearance. Fungal spots are often larger and less angular. Lesions of these diseases may also be present on stems and fruit, though fruit symptoms are distinctly different from the 'bird's eye' spots typical of tomato canker caused by *Clavibacter michiganensis* pv. *michiganensis*. The only way to diagnose BLS with confidence is to get a laboratory identification.

How does it spread?

BLS development favours warm, humid conditions. The bacteria are spread primarily by water and wind, and persist in the field in volunteer plants and crop residue. BLS species are seed transmissible, but do not survive long in the soil. Physical damage to plants, particularly in association with free water also exacerbates bacterial infection and spread. For example, wind-driven rain or hail.

Where does this disease occur?

BLS has been reported worldwide since its initial description in 1921. Since the pathogen was reclassified from *X. campestris* pv. *vesicatoria* to four species in 2004, reports of the new species have increased worldwide. Three of these species were recently confirmed in Australia from research co-funded by government and industry (Hort Innovation Project VN14010) and in collaboration with La Trobe University. In addition to these species, two specific races of *X. euvesicatoria*, races 1 and 7, were also confirmed affecting Australian crops. There are up to ten different races of this pathogen reported overseas, some of which can overcome most of the plant resistance genes currently available in Australia.

How can I protect my farm from bacterial leaf spot?

In Australia, the recommended management strategy for control of BLS in tomato, capsicum and chilli is the use of copper bactericides in combination with a manganese-zinc ethylene bisdithiocarbamate (EBDC) fungicide such as mancozeb. This has provided consistently better control than copper-based products alone in field studies of a range of bacterial diseases, including bacterial spot and speck. This is attributed to the ability of the bisdithiocarbamate anion to chelate copper and transport the Cu^{2+} into the bacteria. Many populations of the BLS-causing bacteria in Australia are known, or expected to have, high levels of copper tolerance. The availability of Cu^{2+} on plant surfaces is a major factor affecting efficacy of control of BLS.

Alternative, non-copper products for control of bacterial pathogens such as those causing BLS are under development by major chemical companies, with one product recently released. Please check the Australian Pesticides and Veterinary Medicines Authority (APVMA) for a list of currently registered products for use in your crop.

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