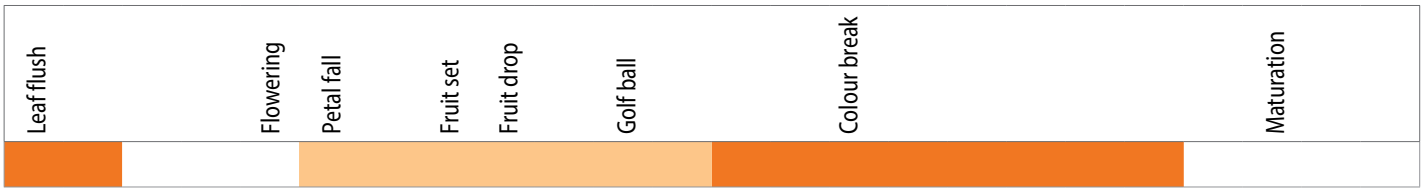
Emperor brown spot Fact sheet

Alternaria spp.

Dale Bennett and Emily Pattison, QDPI, 2025

Table 1. Risk and monitoring period for emperor brown spot infection of fruit.



Description

Emperor brown spot (EBS), also known as Alternaria brown spot (ABS) worldwide, is a fungal disease that affects certain citrus varieties, including mandarins (e.g. Emperor, Daisy, and Murcott), tangerines and their hybrids, such as Minneola tangelos. The disease is caused by the fungus *Alternaria* spp., which produces a toxin largely responsible for its symptoms. This results in notable economic losses, as the disease causes blemishes on fruit and leaves, often leading to early fruit drop and reduced marketability.

Distribution

The disease is prevalent in the citrus-growing regions of Queensland and northern New South Wales (Figure 1), where warm, humid conditions encourage its spread. It thrives in temperatures between 20 °C and 30 °C, especially during extended periods of leaf wetness, such as several days of light rain or fog. It is a particular problem in the coastal areas of Central and Southern Queensland but not considered an issue in North Queensland.

Figure 1. Distribution of emperor brown spot in Australia.

Damage

Fruit symptoms: there are several infection periods, however, the infection risk for EBS is highest in the second half of fruit development, particularly in late autumn. Symptoms include sunken, brown to black spots surrounded by a yellow halo, which can merge into larger damaged areas. Lesions vary from small black specks to large pockmarks, with the rind forming a corky, raised spot (Figure 2). As the disease progresses, pieces of corky tissue might detach, leaving behind necrotic, crater-like depressions on the fruit.

Figure 2. Raised corky lesions on maturing fruit.

On more mature fruit, corky lesions can crack at the edges, creating a 'moat-like' appearance, and during packing, the tops of lesions might be knocked off, making the disease harder to detect.

In all cases, EBS can cause yield losses due to premature fruit drop and cosmetic damage. EBS is considered a disease that affects a large number of fruit with minor/moderate damage, leading to widespread downgrade.

Leaf symptoms: EBS affects citrus leaves by releasing a toxin, which causes distinct foliar damage. Symptoms initially appear as small brown to black spots on young leaves, often developing yellow halos as they mature (Figure 3). These lesions can expand into irregular or circular necrotic areas, sometimes covering large portions of the leaf. The toxin frequently induces necrosis and chlorosis along veins and veinlets, radiating from the lesions.

Figure 3. Emperor brown spot symptoms on flush. Photo: Tamil Thangavel, QDPI.

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Older lesions might flatten and become brittle, developing a paper-like texture in the centre. Severe infections often lead to leaf drop and defoliation of new flush.

Twig symptoms: infections can lead to twig dieback, reducing overall tree vigour. Young twigs are particularly susceptible; when infected, they might experience leaf drop and tip dieback, creating a characteristic 'shepherd's crook' appearance at the top of the tree (Figure 4).

Figure 4. Twig dieback caused by emperor brown spot. Photo: Tamil Thangavel, QDPI.

Similar diseases

Citrus scab: produces corky, raised lesions on fruit and leaves, primarily affecting young tissues.

Citrus black spot: causes black, sunken lesions on fruit, especially in late-maturing varieties.

Citrus canker: alternaria brown spot lesions on fruit can be easily mistaken for citrus canker.

Life cycle

Primary inoculum: EBS is in the canopy (leaves and branches) and on fallen leaves and debris for much of the year, particularly in the tropics and sub-tropics, with conidia dispersed by wind and rain (Figure 5). During warm, wet conditions, the spores can germinate in the presence of moisture on leaves, fruit and twigs and can cause new infections. The incidence of infection in the orchard is influenced by the duration of leaf wetness. These spores typically form from older lesions found on wilting twigs and mature leaves, though fruit lesions might also contribute to the inoculum.

Infection period and symptom development: the disease primarily infects young, expanding leaves and fruit, particularly during periods of high humidity and temperatures ranging from 20 °C to 30 °C. EBS symptoms can manifest rapidly after infection, typically within 24 to 36 hours during optimal conditions of warmth, humidity, and moisture. However, there might be a latency period during which symptoms remain hidden, often becoming visible only as the fruit or leaves mature. This delay can occur if environmental conditions are not conducive to disease expression.

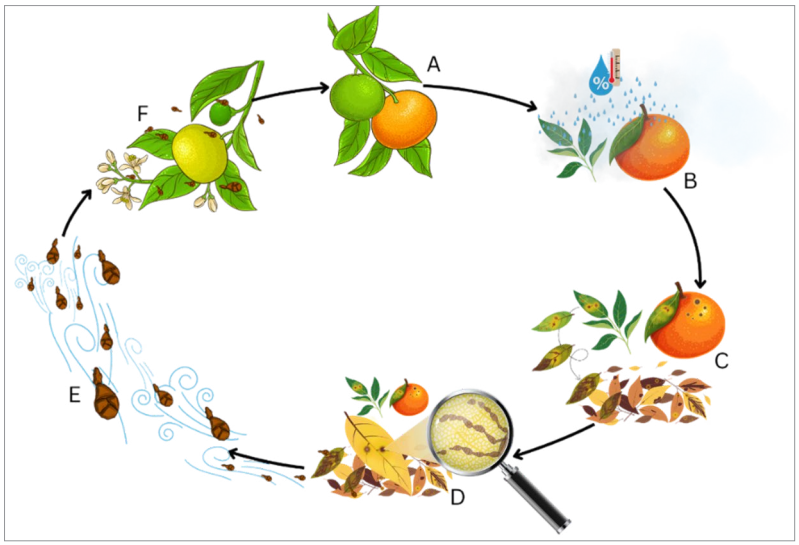

Figure 5. Emperor brown spot life cycle.

A) Latency period: the initial phase after infection when the fruit or leaves appear to be disease-free, which can be days to months in duration.

B) Symptom emergence: infected fruit typically start to show symptoms when environmental conditions are favourable for disease development, specifically during prolonged wet periods, warm temperatures, and high humidity.

C) Disease development: characteristic brown spots appear on fruit and leaves, often with a yellow halo. On leaves, necrosis and chlorosis frequently occur along veins and veinlets, extending from the lesions.

D) Proliferation: the disease progresses on infected fruit, twigs and attached and fallen leaves on the orchard floor, producing a new generation of conidia.

E) Spore dispersal: conidia are dispersed to other parts of the tree or other trees within the orchard via wind and rain.

F) Infection of new growth: conidia settle on developing fruit and leaves, continuing the cycle.

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Monitoring

Monitoring for EBS is challenging, as it can have a latency period during which an infection can occur without visible symptoms. Implementing a preventative program is the most effective way to manage the disease.

Risk period: throughout the year, especially around leaf flush and colour break (Table 1).

Management and control

Cultural

Establishing new blocks: obtain plants from certified nurseries and conduct thorough inspections for lesions before planting to ensure optimal health. It is essential to use disease-free nursery stock, particularly when planting susceptible cultivars. Early introduction of EBS can lead to proliferation during the vegetative growth phase of young trees, making future management more difficult. To reduce disease risk, choose elevated planting sites with good air circulation that allow for rapid leaf drying. Increasing plant density can help reduce disease by reducing leaf drying time and the duration of the wetness. Plant vigour can also be controlled by selecting the appropriate rootstock. Avoid using overhead irrigation.

Managing existing blocks: in mature plantings, control excessive vegetative growth by avoiding overwatering and over-fertilising. Prune to skirt trees, remove infected twigs, and promote good air circulation within the canopy to reduce humidity. Inoculum levels can be reduced by managing leaf litter. This can be achieved by either removing fallen leaves or encouraging their rapid decomposition to minimise the source of spores, and removing dead wood from canopies.

Chemical

Protectant fungicide applications are essential, particularly during the new leaf and fruit development stages. The initial spray should be applied when the spring flush reaches about one-quarter to one-half of full expansion before any disease symptoms emerge. In severe cases, a follow-up spray might be necessary as the flush approaches full expansion, as high levels of infection during this period can complicate the control of EBS on fruit. An additional spray should be administered shortly after petal fall. Subsequent sprays should focus on maintaining a protective coating on the fruit. Registered chemicals are listed in Table 2.

Table 2. Chemicals registered and permitted for the control of EBS. Current as of February 2025.

Chemical name	Example trade name	Notes
Azoxystrobin	Amistar®	- Do not start the fungicide program with an azoxystrobin application. - No more than 2 applications per orchard per year.
Captan	Captan	- PER82043*, expires 31/7/27, mandarin and tangelos only. - No more than 4 applications per orchard per year. - A retreatment interval of at least 28 days is required.
Fluopyram and tebuconazole	Luna® Sensation	- One application per year.
Iprodione	Rovral®	- PER14772*, expires 30/4/26, mandarin and tangelos only. - No more than 3 applications per orchard per year. - A retreatment interval of at least 60 days is required.

* Check the APVMA PubCRIS database for updated permits (https://portal.apvma.gov.au/permits)

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