

The fungus *Botrytis cinerea* is ubiquitous. It has a very wide host range amongst annual and perennial crops, weeds and plant debris and it is present in every orchard at all times. Specific weather conditions however are needed for 'Blossom and shoot blight' to develop in pistachios. It is therefore a sporadic, but economically-significant disease and in California, losses of up to 20 percent of the current crop (plus subsequent loss of fruiting wood), have been reported. The pathogen has not been studied in Australian pistachios, but it is likely to have been the cause of the considerable losses that have occurred in several wet springs.

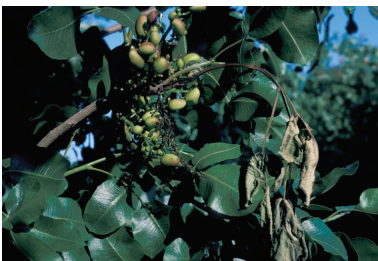


Figure 1: Flagged shoots are one symptom of infection by *B. cinerea*. (Source: T. Michailides)



Figure 2: A cluster with some infected nuts. In the absence of sporulation, the nut symptoms are not diagnostic.

What causes Blossom and shoot blight?

The disease develops in male and female pistachio trees, but male flowers appear more susceptible. The degree of susceptibility varies amongst male cultivars in California, with Peters slightly less susceptible than two Russian selections. The relative susceptibilities of Sirora, Kerman and male pollinators, has not been determined in Australia.

How do I identify blossom blight in my orchard?

Start looking for this disease during bloom, especially if spring is wet. Prolonged spring rains promote the development of this disease.

The fungus infects young, tender tissue and aging, dying or injured tissue. In early spring look for masses of buff-grey spores in catkins. Infected catkins do not drop. Infected shoots are easier to find, but appear later. These are wilted or dead in a typical shepherd's crook shape, with leaves attached (Figure 1). A 'flagged' shoot is not diagnostic of this disease in isolation, but in conjunction with buff-grey spores at its base in early spring, *B. cinerea* becomes a prime suspect.

Later in spring expanding cankers may girdle shoots. The sunken, dark brown cankers form around infected male flowers, in California. They extend longitudinally above and below the original infection point.

Infected leaves develop characteristic V-shaped lesions that start at the midrib and expand towards the terminal leaf end. Rounder leaf lesions may form but these, and fruit lesions, are hard to distinguish from those caused by other fungi. Infected fruit is not common.

How does *Botrytis* infect pistachios?

In winter the fungus survives in various forms on infected plant parts and debris - as spores, fungal strands (mycelium) or as sclerotia (resistant bodies). Sclerotia are common on wood left on the orchard floor.

In spring, sclerotia germinate and the fungus becomes active in cankers. Spores develop on old, infected wood, flower debris, shoots, peduncles and mummified infected fruit. *B. cinerea* on other plants and weeds or debris also produce spores at this time. Spores are mainly spread by wind, but also by rain and insects.

Temperatures and surface wetness duration influence infection of host tissue. The surface moisture may come from rain, dew, fog, mist, and/or irrigation. Canopy humidity, wind and temperatures influence the wetness duration. The optimal temperature range for infection by *B. cinerea* is around 17-23°C. Mild temperatures

outside this range do not stop infection, but the time taken to develop disease symptoms, increases.

In conducive conditions, spores that land on damaged (wounds, natural openings) or decaying, susceptible tissue, colonise and infect rapidly. Infection of intact green tissue is less rapid, but fungal enzymes may assist by killing the tissue in advance of the fungal penetration.

The fungus in active cankers often results in early infection of new shoots emerging nearby. These shoots become brown at the base, and the leaves wilt and die. The dead leaves remain attached to the dying shoots, and this is characteristic of blossom and shoot blight.

What should I do to protect my orchard?

- Accept that the fungus is always present in your orchard.
- In winter take BUDMON samples to gain insight on fungal loads in your orchard.
- In winter, orchard sanitation is critical to reducing carryover of fungal pathogens, especially in lower-lying orchards and those in which blossom and shoot blight has previously occurred:
 - Re-shake trees to remove overwintering infected tissue
 - Remove heavy prunings from the orchard floor
- Prune in winter. It opens canopies, increases air circulation and reduces surface wetness periods.
- In early spring, monitor weather conditions. Understand threatening conditions around bloom, and respond to them.
- Apply appropriate fungicides if prolonged cool, wet conditions, damaging winds or hail occur near or during bloom. Follow up full bloom application with another if bloom is protracted.
- Ensure 100% spray coverage (apply at < 3.2kph) and monitor fungicide effectiveness. *B. cinerea* has the potential to develop resistance.
- In spring, avoid wounding flowers and fresh, green shoots.
- Throughout spring, prune out blighted shoots.
- Throughout spring, clean up early drop fruit and weeds.

The fungicides effective against *B. cinerea* and permitted for use in Australian pistachios include: pyraclostrobin+ boscalid (Pristine®), cyprodinil+fludioxonil (Switch®). Mancozeb with 100% coverage, may also be effective.



Figure 3: Example of *B. cinerea* sporulation on pistachio. (Source: T. Michailides)

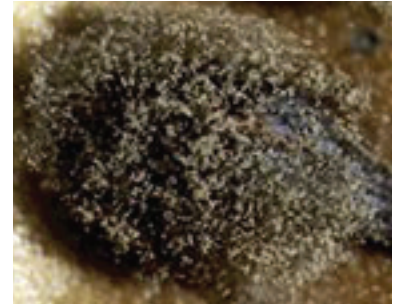


Figure 4a & 4b: Examples of *B. cinerea* sporulation. Note: These are on hosts other than pistachio. (Sources: 4a, Dion Mundy, Ex Beresford, 2004. 4b, MA Hansen.)

References

- Adaskaveg *et al.* 2012. Fungicide, bactericides and biological for deciduous tree fruit, nut, strawberry and vine crops 2012. University of California. <http://cestanislaus.ucdavis.edu/files/143369.pdf>
- Beresford, RM. 2004. Benzimidazole management strategy. <http://resistance.nzpps.org/fungicides.php?p=benzimidazole>
- Bolcan HA, Ogawa JM, Teranishi HR, 1984. Shoot blight of pistachio caused by *Botrytis cinerea*. *Plant Disease* **68**, 163-165. http://www.apsnet.org/publications/PlantDisease/BackIssues/Documents/1984Articles/PlantDisease68n02_163.pdf
- Hansen, MA. 2009. Botrytis Blight of Peony. <http://pubs.ext.vt.edu/450/450-602/450-602.html>
- Michailides TJ. 1991. Susceptibility of pistachio male cultivars to *Botrytis* blossom and shoot blight caused by *Botrytis cinerea*. *Plant Disease* **75**, 410-415. http://www.apsnet.org/publications/PlantDisease/BackIssues/Documents/1991Articles/PlantDisease75n04_410.PDF
- Michailides, T. 1990. Three common pests of pistachio. <http://californiaagriculture.ucanr.org/landingpage.cfm?article=ca.v044n03p6&fulltext=yes;>
- UC IPM Guidelines online. <http://www.ipm.ucdavis.edu/PMG/r605100211.html>