

# SHOT HOLE OF ALMOND (AL16005)

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- Caused by *Wilsonomyces carpophilus*.
- Causes circular tan lesions on leaves which may excise giving a shot hole effect. A diagnostic characteristic is black sporulation in centre of lesion.
- Overwinters in dormant buds.
- Dispersed by rain.
- 8-12 hours of leaf wetness at between 20-25°C is ideal for infection.
- Control is by fungicides, resistant cultivars and avoiding sprinkler irrigation.

## Introduction

Shot hole is a foliar disease found worldwide on *Prunus* species and caused by the fungus *Wilsonomyces carpophilus*. It is usually well controlled by fungicide application but can cause defoliation if left untreated. This is the main cause for concern as severe defoliation can weaken the tree and lead to loss of fruit. Infection of the hull does not reduce kernel quality (Shaw *et al.* 1990) but yield may be adversely affected due to fruit drop if young fruit are infected (Teviotdale *et al.* 1997).

## Identification and symptoms

In almond, lesions are most commonly found on leaves and fruit, twig and flower infections are rare and usually superficial. The plant responds to infection by forming a physical barrier around it, cutting it off from healthy tissue (Adaskaveg 1995).

Leaf symptoms begin as red specks that develop into small circular tan lesions which may have either a purplish or yellow margin (Figure 1). When conditions are right, the fungus will produce black fruiting bodies in the centre of the leaf lesions, which are a diagnostic feature of the disease. Some leaf spots abscise from the healthy tissue giving the characteristic “shot hole” effect. This is dependent on temperature and leaf age; older leaves often retain the lesions whereas those on young leaves fall out (University of California 2017). Adaskaveg (1995) also reports that infections developing at cooler temperatures (15°C) stay attached to the leaf while those forming at warmer temperatures (22°C) detach. The disease may be difficult to diagnose as leaf symptoms can be confused with other issues such as herbicide or copper damage, insect feeding or other fungal/bacterial infections.

Fruit infection produces small corky slightly raised lesions occurring mostly on the upper side of the fruit (Figure 2). Lesions are superficial extending less than 1-2 mm into the hull. Severe infections may produce gum or cause the fruit to deform but usually the kernel is unaffected (Teviotdale *et al.* 1997). Twig infections, if present, are similar to fruit infections (Doll 2020).



**Figure 1.** Shot hole symptom on leaves. Inset photo is by Statewide IPM Program, Agriculture and Natural Resources, University of California.

[www2.ipm.ucanr.edu/agriculture/almond/Shot-Hole/](http://www2.ipm.ucanr.edu/agriculture/almond/Shot-Hole/)



**Figure 2.** Shot hole symptom on fruit.

## Where it comes from

Fungal spores mainly overwinter in healthy dormant buds (Highberg and Ogawa 1986), probably deposited there by rain during autumn, or occasionally in twig lesions. Spores can remain viable for several months until spring when they are dispersed by rain splash to newly developing leaves and flowers. Due to the dispersal method, symptoms may be worse in the lower part of the tree (Teviotdale 1996). Leaf lesions develop fruiting bodies which produce new spores; these are then spread to young leaves or fruit resulting in multiple generations of the disease per season.

## Favourable conditions

Infection is influenced by temperature and wetness; at warmer temperatures a shorter wetness period is needed for infection to take place, but longer wetness periods lead to greater disease severity (Shaw *et al.* 1990). Frequent rain is therefore ideal for disease development as infection requires 8-12 hours of leaf wetness. Temperatures between 20-25°C are most favourable (Adaskaveg 2002) but spore germination and fungal growth can occur at colder (5°C) and hotter (>30°C) temperatures, although with less success (Shaw *et al.* 1990).

Abscission of lesions during warm weather means that spores may not get a chance to form under these conditions, but cooler wet conditions where the infected tissue remains attached allows spore development in the canopy and leads to increased secondary infections (Adaskaveg 2002).

## Control measures

In Australia fungicides in FRAC group 11 (QoL), and 11 in combination with group 7 (SDHI) or 3 (DMI) are registered for use on shot hole as well as groups 9 (AP), M1, M3, M4 and M5 (APVMA 2020). These are commonly used to control a number of different fruit and foliar diseases as part of an orchard's general spray program. Removal of remaining leaves prior to autumn rain and controlling late season infections may be useful for reducing inoculum. Fungicide application for shot hole will be tailored depending on the amount of rainfall predicted in the area and if there is a known risk of infection in the orchard. If there was serious infection in the previous season then sprays could be applied as early as petal fall, otherwise apply sprays as symptoms require. Care should be taken to ensure good coverage of the entire canopy. While shot hole is frequently seen in

Australian orchards it is well controlled by the existing fungicide programs and rarely causes economic damage.

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For further information about the "Integrated disease management program for the Australian almond industry (AL16005)" project led by Agriculture Victoria please visit

[www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/al16005/](http://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/al16005/)

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