

# Fungal diseases in pistachio trees in East-Mediterranean and Southeast Anatolian regions

A. Eskalen\*, M. Küsek\*, L. Dani\_ri\* and S. Karada\_\*\*

\*Department of Plant Protection, Faculty of Agriculture, University of Kahramanmaraş Sutcuimam, 46060 Kahramanmaraş, Turkey

\*\*Pistachio Research Institute, P.O. Box 32, 27001 Gaziantep, Turkey

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**SUMMARY** – Several diseases have been identified on pistachios, some of them causing considerable damage. The following is a list of major fungal diseases of pistachio (*Pistacia vera* L.) determined by pistachio growers in East-Mediterranean and Southeast Anatolian regions. There are six diseases: (i) Septoria leaf spot caused by *Septoria pistaciarum*; (ii) Verticillium wilt caused by *Verticillium dahlia* Kleb.; (iii) powdery mildew caused by *Phyllactinia angulata* (E. S. Salmon); (iv) root and crown rot caused by *Phytophthora* spp. and *Fusarium equiseti* (Cardo) Sacc.; (v) stigmatomycosis caused by *Nematospora coryli* Peglion and *Aureobasidium pullulans* (de Bary) G. Arnaud; and (vi) Aspergillus blights caused by *Aspergillus niger* and other *Aspergillus* spp.

**Key words:** Pistachio, *Pistacia vera*, diseases.

**RESUME** – "Maladies fongiques des pistachiers dans les régions Est Méditerranéenne et Sud-Est de l'Anatolie". Plusieurs maladies ont été identifiées sur pistachiers, dont certaines causent des dégâts considérables. Ce qui suit est une liste des principales maladies fongiques du pistachier (*Pistacia vera* L.) déterminées par des cultivateurs de pistachiers dans les régions Est Méditerranéenne et Sud-Est de l'Anatolie. Il y a six maladies : (i) Septoriose des feuilles causée par *Septoria pistaciarum* ; (ii) Flétrissement causé par *Verticillium dahlia* Kleb. ; (iii) oïdium causé par *Phyllactinia angulata* (E. S. Salmon) ; (iv) pourriture de la racine et du collet causé par *Phytophthora* spp. et *Fusarium equiseti* (Cardo) Sacc. ; (v) stigmatomycose causée par *Nematospora coryli* Peglion et *Aureobasidium pullulans* (de Bary) G. Arnaud ; et (vi) Feu bactérien causé par *Aspergillus niger* et autres *Aspergillus* spp.

**Mots-clés :** Pistachier, *Pistacia vera*, maladies.

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## Introduction

Pistachio (*Pistacia vera* Anacardiaceae) is the only edible crop of 11 species in the genus *Pistacia*. The pistachio is native to western Asia and Asia minor, where still found growing wild in Turkey, Syria, Iran, Iraq, India, Lebanon, Palestine, southern Europe, Asia and Africa. There are seven fungal diseases known to afflict pistachio trees in east-Mediterranean and southeast Anatolian regions. The fruits are classified as drupes with edible seeds. They require a climate with a long, hot summer and moderate winter with at least a 1000 hours under 7.2°C (45°F). They do best in fine sandy loams but tolerate saline or alkaline soils and those with a high lime content. Several diseases have been identified on this crop, some of them causing considerable damage. This was due mainly to new knowledge on the causal agent of pistachio diseases, new farming practices and also to the cultivation of pistachio in new areas with different environmental conditions resulting in changes in the epidemiology of the different diseases. The following diseases have been observed. Pistachio growing mostly in dry areas are rarely infected by root rooting fungi.

## Verticillium wilt

Verticillium wilt caused by *V. dahlia* Kleb. has been found almost in all pistachio growing areas of the many country, and it is considered as the most common and damaging diseases of this crop. The disease may kill young trees, while in fully grown trees usually only branches die. Trees of any age are subject to attack and hundreds die each year. The fungus, which attacks pistachios, also attacks cotton, tomatoes, melons, stone fruits and weed species, also serve as hosts, and these enable the pathogen to become established in non cultivated land.

The first symptom of *Verticillium* wilt are interveinal patches of yellowing or scorching of the leaves on affected branches. Collapse of the branch with the first warm weather because root system that attack of *Verticillium* provide enough water. The classic symptom of *Verticillium* wilt is rapid dry and death of one or more branches or whole tree, usually in late spring or early summer.

In another symptoms of *Verticillium* wilt develop slowly over several years and called "thin leaf decline". Thin leaf decline is characterised by gradual thinning of the canopy and reduction in growth and yield.

Xylem elements infected by *Verticillium* become clogged by substances elaborated by the fungus and the tree. These substances are darkly pigmented, and a cross-section of an infected root, trunk, or branch reveals the pattern of *Verticillium* infected in the new xylem: scattered black speckles or a more or less discontinuous black ring depending upon how many vessels are infected. The discoloured xylem elements are non-functional and cannot transport water to the upper portions of the tree. The branches that die are these which are connected to the infected root and vascular system and no longer receive adequate water.

*Verticillium* survives in soil the form of resting structures called microsclerotia. Each microsclerotia is approximately 30 dark-coloured cells. They are extremely hardy and remain viable in soil for many years. Several hundred microsclerotia can be present in a cm<sup>3</sup> of soil, and most microsclerotia are found in the upper 15 cm of soil.

The microsclerotia is also the infective unit of the fungus. It remains quiescent in soil until a plant root grows nearby releasing substances (nutrients) which stimulate it to germinate. These substances can be produced by the roots of both host and non-host plants, but only young or wounded roots produce sufficient quantities of nutrients to cause the microsclerotium to germinate. Entry occurs just behind the root tip and fungus may grow into the new xylem. Inside the xylem element, the fungus produces mycelium and conidia. The conidia are carried up with water. Conidia germinate and more mycelium is formed. In this manner the fungus spreads from root to shoots, plugging the xylem vessel along the way. Neighbouring xylem vessels are not easily infected. Thus, many independent infections may be needed to involve a large portion of the water conducting system. The fungus involved a few cortical cells, outside the vascular tissues, and there forms a new microsclerotium which later is returned to the soil.

## Root and crown rot

Root rot caused by *Phytophthora* spp. is one of the most important phytopathological problems in pistachio areas. Above-ground symptoms of root rot usually develop slowly, and diseased trees show reduced growth, thinned canopy and early defoliation for several years. Trees with crown rot typically die within a year or two after inoculation. The bark and outer wood of infected roots and crowns are discoloured, but the mycelium of *Phytophthora* in the infected tissues cannot be seen by naked eye.

*Phytophthora* infections on the trunk or scaffolds of trees form cankers in the bark, and the tree gums profusely.

As many as 100 zoospores develop inside each sporangium, and when the soil is flooded, the zoospores are released. They are attracted to root exudates and swim to the root surface. There they attach themselves and invade the tissues to establish an infection. Free moisture is required for both the production and dissemination of the zoospores. Consequently, root and crown rots are associated with heavy soils and prolonged periods of high soil moisture. Alternating cycle of wet and dry soil are known to exacerbate *Phytophthora* diseases in some crops. Stressed plants often are more susceptible to infection.

## Septoria leaf spot

Septoria leaf spot is caused by the specie *Septoria pistaciarum* (*Mycospharella pistaciarum*). In years with high diseases incidence *S. pistaciarum* may also attack the fruits. This species primary infections are produced by ascospores released from pseudothecia in overwintering leaves on the

ground. These diseases are common and especially in years with rainy springs, they may cause heavy defoliation in late summer. Leaf spot from natural infections are round to irregular, 1-2 mm diameter, with 1 to 20 flask-like fruiting structures of the fungus (pycnidia). Pycnidia measure 60-108 µm in diameter, pycnidiospores are colourless, curved to scale-shaped, and 44-85.5 x 3-3.9 µm, with 3 to 9 septa.

## Stigmatomycosis

This disease has been reported from almost all the countries where pistachios are grown. Stigmatomycosis caused by the fungi *Nematospora coryli* Peglion and *Aureobasidium pullulans* (de Bary) G. Arnaud. It was found on open and closed nuts with an incidence that reached up to 80% of the nuts. No external symptoms were visible. Internal symptoms were brown necrotic areas and malformation of the cotyledons. The asci and characteristic spindle shaped ascospores of the fungus were found in a spongy material formed between the cotyledon and their enveloping membrane. After this first observation the disease was found occasionally in nuts late in the season but it never produced any serious damage. More than ten different species of hemipteras have been reported as pests which after feeding on pistachio nuts cause epicarp lesion on developing fruit early in the season and kernel necrosis later in the season after feeding directly on the kernel of nuts.

Stigmatomycosis of pistachio is characterised by the wet, smelly, rancid, slimy appearance of the kernel. In contrast, typical kernel necrosis symptoms caused by hemipteras are dry, punchy, areas in the kernel, spongy at times, usually appearing in the area close to the stem and or along the split line of the shell. The major symptoms of the stigmatomycosis were observed in kernels collected from various orchards: (i) small kernels not fully developed, dark green with brown funiculus, in contrast to kernels with undeveloped embryos; (ii) kernels which developed normally and fill the shell cavity but are partially or totally wet, smelly, and rancid in contrast to healthy, green kernels; and (iii) kernels which fill the shell cavity but look abnormal, being white or light yellow and jelly-like, with a lobed appearance.

## Powder mildew

Powder mildew caused by an unidentified powder mildew species (lack of cleistothecia development). However, *Phyllactinia guttata* (Wallr.:Fr.) Lev. has been reported on *Pistacia terebinthus* L. The fungus grows superficially as white powdery mycelial masses. Later the mycelia die, leaving a brown scar. Similar symptom can be found on rachises, fruit stem, petioles, underside of leaf blades, and young shoots. The conidia of the fungus are produced in short chains and are hyaline, one-celled and barrel shaped.

## Aspergillus blights

Aspergillus blights caused by *Aspergillus niger* and other *Aspergillus* spp. Aflatoxin has been found so frequently in pistachio nuts from countries in the Middle East, that it has created great concern about its possible presence in pistachios grown in California.

Several recent studies suggested preharvest contamination of pistachio nuts with *A. flavus*, the fungus producing the aflatoxin. *A. flavus* was isolated both from pistachios containing aflatoxin. Aflatoxin was also detected on early split nuts, infested and non-infested by the navel orangeworm.

The elimination of early split nuts after harvest would require extensive and expensive sorting before hulling. While such a sorting apparatus would be very costly if done by humans, electronic colour sorters could detect early split nuts after hulling by the distinctly dark surfaces. The shells of early split nuts usually have stains; a characteristic dark stain along the suture can help the identification and sorting of the nuts. Aflatoxin analyses of early split nuts shows that more than 99% of the aflatoxin contamination is associated with early split nuts. Therefore, it is mandatory that these nuts are recognised and sorted out to reduce aflatoxin to non-detectable levels.

## Further reading

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