

HEALTH STATUS OF PLANE TREES (*PLATANUS* SPP.) IN SPAIN

by M.L. Tello¹, C. Redondo¹, and E. Mateo-Sagasta²

Abstract. The plane tree (*Platanus* spp.) is one of the most frequently used ornamental trees in Spanish urban areas. For the past 30 years, the health of urban tree plantings in various parts of the Iberian Peninsula has been observed and a number of diseases, common to the majority of them, detected. The most frequently occurring diseases that affect *Platanus* spp. are anthracnose (caused by the fungi *Sporonema platani* Blaüml.) and powdery mildew (caused by *Microsphaera alni* (DC.) Wint.), as well as diseases caused by other minor pathogens. Since 1997, we have focused our research on surveying the state of health of urban trees in the town of Aranjuez (Madrid), as an example of an urban location in central Spain. Within the numerous tree species that exist in the town, a serious problem was detected among plane trees. The symptoms observed (young shoots and branches up to 3 years old growing in whorls, necrotic tissue close to phloem and xylem, premature defoliation) indicate the possible existence of *Gnomonia veneta* (Sacc. et Speg.) Kleb, anamorph *Sporonema platani* Blaüml. The majority of the trees show these symptoms to one degree or another. Applying diagnostic and identification methods in the laboratory, we were able to demonstrate the presence of *S. platani* in all of the samples collected from symptomatic trees. A detailed description of the two main diseases, anthracnose and powdery mildew, in Spain is presented, with special reference to symptoms and dispersal under Spanish environmental conditions. A discussion about the most appropriate control methods is included.

Key Words. *Sporonema platani*; *Microsphaera alni*; *Ceratocystis fimbriata*; diseases; urban trees; anthracnose; powdery mildew; canker stain; phytopathological fungi.

Plane trees (*Platanus* spp.) are among the most abundant urban trees in Spain, used primarily in linear plantings along streets but also in public and private parks and gardens. Most probably all of the plane trees in Spain are genetically variable descendants of hybrids between the eastern American sycamore (*P. occidentalis* L.) and the "Turkish" plane (*P. orientalis* L.). The valid name of this hybrid combination was considered to be *P. × hybrida* Brot. in the first edition of *Flora Europæa* (Tutin 1964) but was changed to the

more commonly used *P. × acerifolia* (Ait.) Willd. in the second (Tutin and Edmondson 1993) edition. In the text that follows, "*Platanus* spp." will refer to this assemblage of hybrids.

Considered very hardy and resistant, plane trees in Spain did not show important health problems until the beginning of the 1970s (1970–1971). At that time, the first symptoms of anthracnose were observed in central Spain, while at the same time an attack of powdery mildew appeared on planes in the Mediterranean coast. These events also coincided with the incidence of canker stain in plane trees of the Côte d'Azur in southern France. Until these first reports, the planes had been in an excellent state of preservation, apart from a few problems on roots. Since the discovery of anthracnose and powdery mildew, observations of the health of plane trees in the urban environment of several Spanish cities have been made and the spread of these two diseases followed.

Observations made during the past 30 years over the entire Iberian Peninsula are now being systematically made on the trees of the town of Aranjuez, chosen as an example of an urban site in central Spain. In Aranjuez, this detailed study of urban and periurban trees has been carried out since 1997.

Aranjuez is a small town (less than 40,000 inhabitants) near Madrid. The town has historical sites surrounded by more than 40 km (25 mi) of promenades bordered by two, four, or even six rows of trees. In this town, the majority of the urban trees are of the genus *Platanus*. Some are magnificent examples more than 2 centuries old (the oldest plane trees in Spain) and more than 30 to 40 m (100 to 130 ft) tall. But, unfortunately the vast majority of them are affected by anthracnose to one degree or another.

EFFECT OF THE PHYSICAL ENVIRONMENT

Although the ideal environment for *Platanus* spp. is a mild, temperate climate, in Spain the tree appears in all regions, from Galicia (northwest) to Andalusia (south). Impressive trees up to 70 years old can be

found in San Sebastian (north) and in Madrid (central). They withstand all climates perfectly and for this reason in the Iberian Peninsula they are found in the three climatological zones: Atlantic (humid and colder), Continental (extreme conditions: very hot in summer and very cold in winter), and Mediterranean (dry and warm). The influence of the coast needs to be highlighted. The effect of the sea softens the temperatures; hence, they are not extreme. Along the Mediterranean coast, two zones can be distinguished: a warm area from Tarragona (north) to the south of Alicante, and the hotter southern coast from Murcia to Malaga, where temperatures can easily reach up to 40°C (104°F).

Platanus spp. withstand climatic irregularities, the most serious being the late frosts in the two plateaux, although generally the species copes with these frosts with few problems. The quantity of necrotic shoots and leaves caused by frost is practically nil. What normally happens is that the fungal pathogen causal agent of anthracnose (*Sporonema platani*) provokes a type of leaf necrosis that can be confused with the effects of late frost, leading to diagnostic errors.

The planes survive the hard, hot summers well and, unlike other tree species in the same areas, show no desiccation of shoot tips due to high temperatures. However, attacks of powdery mildew can cause these same symptoms. With regard to premature defoliation caused by diseases, *Platanus* spp. demonstrate an ability to reshoot from adventitious buds, such that if the initial shoots are stopped by disease, it is disguised by the effect of the adventitious shooting. They also cope well with drought, although they clearly appreciate irrigation in particularly dry years. Neither does the soil type impose a determining factor in the growth of these trees.

FUNGAL DISEASES

Anthracnose

Taxonomy. According to Goidànich (1964), the causal agent of anthracnose of the plane tree is the fungus *Gnomonia veneta* (Sacc. et Speg.) Kleb., whose anamorphs are *Discula platani* (Peck.) Sacc., *Gloeosporium nervisequum* (Fkl.) Sacc., *Sporonema platani* Baüml., and *Microstoma platani* Eddelb. et Eng. Before Goidànich, Viennot-Bourgin (1949) cited the teleomorphs *Gnomonia* (*Apiognomonina*) *veneta* (Sacc.

et Speg.) Kleb. and *Laestadia veneta* Sacc. et Speg., and the anamorphs *Gloeosporium nervisequum* (Fkl.) Sacc., *Gloeosporium platani* (Mont.) Oud., *Discula platani* (Peck.) Sacc., *Sporonema platani* Baüml., and *Microstoma platani* Eddelb. et Eng. Later, Sutton (1980) named this fungus *Apiognomonina errabunda* (Rob.) Höhn and its anamorphs *Discula umbrinella* Berk. et Br., *Gloeosporium umbrinellum* Berk et Br., *Gloeosporidium umbrinellum* (Berk et Br.) Petrak, and *Myxosporium platanicola* Ell. et Ev. Sutton explained that *A. errabunda* includes the two species *Gnomonia platani* Kleb. and *G. quercina* Kleb. The sexual stage is included in the class Ascomycetes, family Gnomoniaceae.

In this article, we have chosen the name *Sporonema platani* to refer to this fungus because that is the stage that can usually be seen in Spain.

Morphology. Sutton (1980) described the conidial stage of the fungus as an acervular conidiomata (up to 150 µ diameter), which is epidermal, separate, or confluent and with irregular dehiscence.

We detected some differences in the conidiomata, depending on whether it is formed on the leaves or on the twigs or shoots, and being more open when formed on twigs or shoots (Figure 1 and Figure 2). The conidiophores are hyaline, septate, and branched at the base only. The conidia are hyaline, aseptate, smooth, thin-walled, and straight or slightly curved; the apex is obtuse; the base is more or less truncate, ellipsoid, or clavate, with a size of 9.5 to 12 × 3.5 to 5 µ.



Figure 1. Closed conidiomata of *Sporonema platani* on leaf of *Platanus* spp.



Figure 2. Open conidiomata of *Sporonema platani* on twig of *Platanus* spp.

The mycelium is intercellular in the leaves (Viennot-Bourgin 1949), immersed, branched, septate, and hyaline or pale brown (Sutton 1980). The sexual stage is characterized by globose, immerse, short-necked (130 to 400 μ) perithecia. Asci (40 to 55 \times 9 to 13 μ) carry eight hyaline, two-celled, ovoid ascospores (12 to 16 \times 4 to 6 μ) (Viennot-Bourgin 1949).

Evolution. As indicated earlier in this article, the fungus *S. platani* was detected for the first time in 1970–1971 when it affected leaves and produced a spectacular and important defoliation in summer (July and August) on the trees of the central part of the Iberian Peninsula, causing alarm among experts.

In Madrid, the disease started in the university area and extended to other parts of the city. It was detected and classified following the description and methods given by Viennot-Bourgin (1949). The symptoms he had observed in the plane trees of Paris in the 1920s were located on the young branches. The disease led to the replacement of many the plane trees with maples. The fungus slowly spread to all of the Madrid region and central Spain, taking 10 to 12 years before all the symptoms were visible.

In Spain, the disease is present from Sierra Morena (north of Andalusia) to the north of the peninsula, although it took a long time to arrive at the Mediterranean coast and Andalusia. Now, few trees are affected in the hottest parts of southern Spain and the Mediterranean coast, indicating that the limiting factor must be high temperatures.

Symptoms. The symptoms or damage that *S. platani* produces are the following:

1. **In leaves.** In favorable environmental conditions (mild temperatures and high humidity), the fungus penetrates principally into leaf veins and moves slowly through the vessels, where it spreads to the nearby tissues and produces necrosis. When this necrosis affects the petiole, it provokes premature desiccation and leaf-fall. This type of attack is not normally very important, although it produces a defoliation that in exceptionally favorable years can reach a greater importance and cause premature leaf-drop in the trees of central Spain near the end of May or in early June.
2. **In shoots and twigs up to 3 years old.** This is the most serious damage produced by *S. platani* in the climatic conditions of central Spain. The fungus can enter the buds and overwinter there, producing bud death and preventing shooting. This can lead to the formation of adventitious buds around the dead bud and the sprouting of leaves from these adventitious buds. More commonly, as a reaction to the fungal attack, the shoots from these adventitious buds grow in whorls (when there is a proliferation of too many buds at the base of the shoot). They are shorter than normal, with shorter internodes. The shoots also can suffer irregular attacks of the fungus, depending on the environmental conditions, such that some die and others remain healthy, although with time, the fungus invades and eventually kills them all (Figure 3). The fungal attack can be delayed if conditions



Figure 3. Symptoms of anthracnose on wood up to 3 years old on *Platanus* spp.: lesion on 2-year-old wood and adventitious shoots growing in whorls.

are less favorable, and then shoots and leaves have a chance to develop. When the fungus eventually does develop and kill the shoots, the leaves desiccate because sap fails to reach them, without signs of the parasite in them. The dry, necrotic appearance of the leaves is clearly visible and spectacular and, as mentioned before, can be mistaken for other irregularities suffered by the tree, such as late frosts.

3. **In branches more than 3 years old.** The progress of the disease to wood older than 3 years produces cankers and necrotic lesions. As a reaction, numerous adventitious buds and shoots can be produced around the lesion, a consequence of the flow of sap around the cankers. These damaged branches are fragile and can break easily. The succession of breaks and new growth in the same branch produces the characteristic growth in angles (Figure 4). As the disease progresses and according to the size of the tree, most of the young wood (shoots and young branches) die, leaving the appearance of desiccated trees with no leaves, although the radicular system is in perfect condition and can provide enough sap. As a reaction, the tree produces new leaves from adventitious buds on the older branches and even on the trunk. That can mean the tree survives a few years more (up to 6 years) (Figure 5). In the final stage of the disease, the tree is unable to produce new bark to replace the old, and it loses its characteristic bicolored, patched bark. The bark of the diseased tree turns dark brown instead. The tree will die in two or three years, and it is then possible to isolate fungi such as *Ganoderma* spp. from the wood.

Another remarkable phenomenon observed is the diverse disease sensitivity shown by each tree. In these cases, the different genotypes of the hybrids allow differences in disease severity among trees growing under the same environmental conditions, though eventually all trees are affected to some degree or another.

The fungus is capable of producing a certain amount of disease, affecting a certain area or volume of the tree. If the tree affected is young, that amount of disease will cause the rapid appearance of symp-

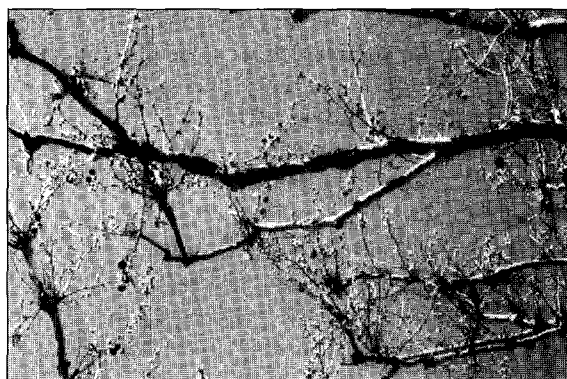


Figure 4. Symptoms of anthracnose on wood more than 3 years old on *Platanus* spp.: cankers, shoots growing in whorls with short internodes, and growth of branches in angles.



Figure 5. Plane tree in final stage of anthracnose: production of leaves on old wood and trunk; young shoots and branches dead.

toms. If the attack is on an old tree, the symptoms may remain hidden for a longer time.

It is difficult to achieve an exact measure of the intensity of the attack, and it is not possible to use mathematical criteria; therefore, a visual criterion is

used. Only our own experience tells us that three phases of the disease incidence can be distinguished: initial, medium (low and high), and high.

Dispersal of the disease. The disease is spread by spores. Masses of mucilaginous spores are formed at the exit of the fruit body, so that the wind cannot easily disseminate them. Water, however, which hits the spores as rain drops and disperses them—especially water that runs off and drips—collects the spores and deposits them in the nodes, branching, and growing points of the leaves. The inoculum can also be spread to the upper part of the tree by the upward movement of leaves by the wind.

In Madrid, some streets have an important level of attack, while other streets have no affected trees. Buildings constitute a physical barrier that prevents movement of leaves and therefore of the inoculum.

Invasion of older wood is possible, but in Spain it is not normal because the period of attack is shorter than in regions with a more favorable climate. The optimal temperature for sporulation and dissemination of the disease is between 24°C and 25°C (75°F and 77°F), with high ambient humidity (saturation). The most dangerous time, therefore, in the center of Spain is in spring, from 15 May to 15 June, with abundant rain.

In the climate of central Spain, our experience shows that the mycelium of the fungus, inside the host, resists proven external temperatures of -12°C to +42°C (10°F to 108°F), referring to minimum night and maximum day temperatures. This has been shown only by observation of the trees in the town of Madrid, given the difficulty of statistical testing on linear plantings.

As a consequence, in central Spain rainfall determines the severity of the attack on the trees because the inoculum is always present—since it can withstand very extreme external temperatures.

Control methods. Application of fungicides offers efficient control in relation to the inhibition of spores present at that moment, but it is technically unpredictable and results are erratic. Even when the leaves are subject to occasional low temperatures, the fungi can spore after only 5 days at optimal temperatures. These temperatures (24°C to 25°C [75°F to 77°F]) can occur in Spain at any time and in any season. This means a continual application of the fungicide would be necessary (every 15 to 20 days, according to fungicidal persistence), which is unaffordable in practice,

especially for urban trees. With luck, one application at the right moment and when the temperature cooperates can be successful, but the same results cannot be expected another time under different circumstances.

When the tree has a low or medium level of attack, the removal of all material that carries the inoculum (wood 3 years of age and younger) provokes healthy shoots to grow and, although the disease is not eliminated, the tree looks healthy and the disease severity is kept at a low level (Figure 6 and Figure 7).

The effect of this type of pruning can last 3 to 7 years in the worst and best cases, respectively. Sanitary pruning does not eliminate the disease, so the treatment must be repeated.

If the tree is in an advanced phase of the disease, the stress produced by the intense pruning can accelerate the death process.

An empirical demonstration of the benefits of sanitary pruning can be seen in plane trees in Spain. There are two classical types of pruning treatment of *Platanus* spp.: either no pruning or intense pruning (candelabra-like), in which the skeletal branches of the tree grow



Figure 6. Poorly pruned trees (young infected shoots have not been removed). The leaves are being produced from older wood only.



Figure 7. The authors advocate removal of all material that carries the inoculum. The new sprouts are healthy.

very low, giving shade for the promenades. In this technique, all the young branches and shoots are removed. The trees pruned this way are free of the symptoms of anthracnose, apart from a limited attack on leaves that does not pass to the branches.

Powdery Mildew

Taxonomy. Viennot-Bourgin (1949) considered the following synonyms: *Microsphaera alphitoides* Griff. et Maubl., *Microsphaera quercina* (Schwn.) Cke. et Peck p.p., *M. Alni* (Wallr.) Wint. p.p., and *M. alni* (DC) Wint. var. *extensa* (Cke. et Peck.) Salm. *F. quercina* Neg. Goidànich (1964) used the names *Microsphaera alphitoides* Griff. et Maubl., *Microsphaera quercina* (Schwein.) Burr, *M. extensa* Cooke et Peck., and *M. alni* (Wallr.) Wint. et Salm. According to the Commonwealth Mycological Institute (Mukerji 1968), *Microsphaera alni* (Wallr.) Wint. sensu Salomon is a synonym for *Microsphaera alni* (DC.) Wint., *Microsphaera penicillata* ([Wallr.] Fr.) Lév.; *Alphitomorpha penicillata* Wallr.; *Alphitomorpha penicillata* Wallr. var. *alni* Wallr. and *Erysiphe penicillata* (Wallr.) Fr.

Based on the perfect (sexual) stage, powdery mildews comprise the family Erysiphaceae in the order Erysiphales, class Pyrenomycetes. According to the imperfect (asexual or conidial) stage, they are classified in the family Moniliaceae, order Moniliales, class Deuteromycetes (Yarwood 1978).

Morphology. The perfect stage of the Erisiphalfungi is not found commonly, so in practice, it is more convenient for diagnostic purposes to describe these fungi according to their imperfect stage. The white mycelium covers the surface of the plants, and large unicellular conidia are produced at the terminal ends of the conidiophores (Yarwood 1978). A complete morphological description of *M. alni* is given by the CMI (Mukerji 1968).

Evolution and symptoms. Powdery mildew of plane was first detected in Spain approximately 30 years ago. Almost at the same time that *S. platani* affected trees in the central Spain, severe early defoliation occurred during July and August along the southern coast of Spain (Costa del Sol, Málaga). Diagnosis of the disease was easy because powdery mildew was detected on the leaves.

At the end of winter (end of February until mid March), the first spots on leaves and shoots appeared, causing intense defoliation by the end of summer. This effect can happen sooner or later depending on the climatic conditions of the year.

In Spain, *M. alni* spread to the whole of the Mediterranean coast from Malaga to Gerona (in the north of Catalonia). Although not known, it cannot be discarded that another initial place of infection could have existed.

The plane tree can overcome this disease by shooting of adventitious buds. The severity of powdery mildew of plane seems to be less than that of anthracnose and the trees can survive, even though it is not possible to calculate accurately the stress that this pathogen produces on the host.

Control methods. Some control treatments have been tried but with little effectiveness. One of the most effective control methods, complementary to chemical treatment, is pruning and discarding diseased shoots at the end of winter or beginning of spring, in the case of shrubs.

The experience with large trees indicates that this treatment is effective only in the initial stages of infection. Severe pruning can aggravate symptoms of the disease because new, tender shoots are highly suscep-

tible (as is the case with oaks) (Butt 1978). Van der Plank in 1963 (cited by Butt 1978) had already inferred that sanitation treatments aimed at reducing primary inoculum were unlikely to be sufficient for the control of pathogens that have a potentially high infection rate, as is the case of powdery mildews.

It is worth mentioning that detailed studies in the laboratory are extremely difficult due to the special characteristics of this type of fungi (different behavior of conidia, influence of host epidermis, being an obligate pathogen, etc.).

In other countries with other hosts, researchers tried different methods to control powdery mildew diseases, although they were not very effective. Lim and Rao (1975), as cited by Butt (1978), described the manipulation of the timing of the vegetative season in order to avoid the infection. The technique was used in rubber plants by provoking early defoliation with chemicals. After that, a quick refoliation takes place and a serious epidemic is avoided.

Powdery mildews cope with drought and heat better than other fungi do. The causal fungus belongs to a group of pathogens that has proved to be very dangerous in the central part of Spain, due to its climatic conditions, on hosts such as vine, roses, euonymus, and other ornamental trees and shrubs. That is why it was expected that *M. alni* would spread to most of the Iberian Peninsula, as was the case with *Sporonema platani*. However, the spread did not occur and, although the inoculum of *M. alni* has reached the central area of Spain, only under especially favorable climatic conditions (which do not occur often—approximately once in 10 years) does the fungus produce damage of importance.

One of those exceptional years was 1998, with high rainfall in spring and summer. In Madrid, a spectacular defoliation on the plane trees caused much concern in the general public. By contrast, this year's poor rainfall leads us not to expect the same results, even though the inoculum obviously must be present in large quantities.

The lack of methods that can reliably make meteorological forecasts makes it impossible to determine in advance when a fungicidal treatment is going to be needed, so its efficacy is unpredictable. Also, we must consider the high cost and the difficulties of applying phytosanitary treatments to trees as tall as 30 m (100 ft).

Canker Stain

The disease called canker stain of plane tree is caused by the fungus *Ceratocystis fimbriata* Ellis et Halst.

Taxonomy. Viennot-Bourgin (1949) gave the following synonyms to add to *Ceratocystis fimbriata* Ellis et Halst.: *Ceratostomella fimbriata* (Ellis et Halst.) Elliot, *Sphaeronema fimbriatum* (Ell. et Halst.) Sacc., and *Ophiostoma fimbriatum* (Ell. et Halst.) Nannf. More recently, in 1964, Goidanich cited *Endoconidiophora fimbriata* (Ell. et Halst.) David, *Ophiostoma fimbriatum* (Ell. et Halst.) Nannf., and *Ceratostomella fimbriata* (Ellis et Halst.) Elliot. This fungus is included in the class Ascomycetes, order Plectascales.

Morphology and symptoms. A detailed morphological description of *Ceratocystis fimbriata* is given by the CMI (Morgan-Jones 1967). The fungus causes reddish brown lesions on old branches and the trunk, in a vertical strip and lightly depressed. The disease is transmitted by natural grafting between roots of nearby trees or by water runoff. Pruning utensils also can carry the inoculum.

Importance in Spain. In Spain, this pathogen has been detected in some fruit trees (e.g., *Pyrus* spp.) and although the inoculum is present, it has never caused an important disease. When *C. fimbriata* began to act as a relevant pathogen on plane trees on the Côte d'Azur of France, a search was started in Spain, suspecting it could act in the nearby Spanish Costa Brava, which shared a similar climate. However, the fungus was not detected in the areas where *Sporonema* acted, apart from a few cases in Gerona (northern Catalonia). Due to the stress caused in planes by *S. platani*, it is likely that *C. fimbriata* can cooperate as a secondary pathogen under certain circumstances.

Other Minor Pathogens

In Spain, wood-rot fungi (*Ganoderma*, *Fomes*, etc.) do not have much importance, even though they do appear—primarily in old trees, where they accelerate the death of the tree. However, this is not seen as very important in terms of use and survival of the remaining trees.

Other fungal pathogens of no importance as pathogens of plane trees in Spain are the following:

- *Leptothyrium pomi* (Mont. et Fr.) Sacc. = *Microsticta pomi* (Mont.) Desm. = *Labrella pomi* Mont.

- *Melanopus squamosus* (Huds.) Pat. = *Polyporus squamosus* Fr.
- *Physalospora cydoniae* Arn. = *P. obtusata* (Schw.) Cke. = *P. malorum* Shear = *Melanops quercuum* (Schw.) Rehm f. *vitis* Sacc. Conidial stage: *Sphaeropsis malorum* Peck = *S. pseudo-diplodia* (Fck.) Del. p.p. = *Diplodia pseudo-diplodia* Fck. p.p. = *Macrophoma malorum* (Berk) Berl. et Vogl. = *Sphaeropsis malorum* Berk = *Botryodiplodia mali* Brun. = *Diplodia maura* C. et Ell.
- *Polyporus sulfureus* (Bull.) Fr.
- *Stereum purpureum* Pers. = *Thelephora purpurea* Fr.
- *Stigmina platani* (Fck.) Sacc: generally saprophytic, though it can produce tiny stains (a few millimeters) on the undersides of leaves. In winter, it can produce the sexual stage of the genus *Mycosphaerella* (Viennot-Bourgin 1949; Goidànich 1964).
- *Xanthochrous hispidus* (Bull.) Pat. = *Polyporus hispidus* Fr.

CONCLUSION

The most relevant diseases affecting plane trees in Spain are anthracnose and powdery mildew. Anthracnose is widespread throughout the Iberian Peninsula, except for central Andalusia and the Mediterranean coast. Most of the plane trees are affected to some degree. On the other hand, even though the inoculum is present in other regions, powdery mildew causes much more damage on trees along the Mediterranean coast, from Catalonia (in the north) to Andalusia (in the south).

Even though the trees affected by anthracnose can survive for a long time (years), their ornamental value decreases in the third or fourth year after infection, when the characteristic symptoms (necrotic leaf veins, lack of budding, growth in whorls, cankers, etc.) are visible. The severity of the disease can even cause early defoliation, which makes the trees unable to offer enough shade—an extraordinarily important role in the towns of central and southern Spain.

We focused our present studies on the town of Aranjuez (central Spain), where anthracnose is widespread in plane trees, and because these trees constitute a significant proportion of the total number of trees in the town, we are particularly concerned about their pathological state. Sanitary pruning, in which all of the young shoots and branches (up to 3

years old) are removed, can be the best way of keeping the disease under control. At present, possible control methods in Aranjuez are being studied, including sanitary pruning.

Powdery mildew forms a white, powdery covering on leaves, decreasing a tree's ornamental value and leading to early defoliation in cases of intense incidence. In Spain, it is a disease less severe than anthracnose. The first attacks in Spain were observed in the southern coastal areas (at the same time that anthracnose started in the central regions). Canker stain, at the moment, does not seem to be a dangerous disease in Spain, unlike in France.

LITERATURE CITED

- Butt, D.J. 1978. Epidemiology of powdery mildews, pp 51–73. In Spencer, D.M. (Ed.). *The Powdery Mildews*. Academic Press, London, England. 565 pp.
- Goidànich, G. 1964. *Manuale di Patologia Vegetale*. Vol II. Edizione Agricola Bologna. Bologna, Italy. 1,283 pp.
- Lim, T.M., and B.S. Rao. 1975. International Rubber Conference 1975, Kuala Lumpur, pp. 1–19.
- Morgan-Jones, G. 1967. *Ceratocystis fimbriata*. Descriptions of Pathogenic Fungi and Bacteria No.141. C.A.B. Commonwealth Mycological Institute, Kew, Surrey, England.
- Mukerji, K.G. 1968. *Microsphaera penicillata*. Descriptions of Pathogenic Fungi and Bacteria No. 183. C.A.B. Commonwealth Mycological Institute, Kew, Surrey, England.
- Sutton, B.C. 1980. *The Coleomycetes: Fungi Imperfecti with Pycnidia Acervuli and Stromata*. Commonwealth Mycological Institute, Kew, Surrey, England 696 pp.
- Tutin, T.G. 1964. *Platanaceae*, pp 384. In Tutin, T.G., V.H. Heywood, N.A. Burges, D.H. Valentine, S.M. Walters, and D.A. Webb. (Eds.). *Flora Europaea*, Vol. . Cambridge University Press, Cambridge, England.
- Tutin, T.G., and J.R. Edmondson. 1993. *Platanaceae*, pp 463. In Tutin, T.G., N.A. Burges, A.O. Chater, J.R. Edmondson, V.H. Heywood, D.M. Moore, D.H. Valentine, S.M. Walters, and D.A. Webb. (Eds.). *Flora Europaea*, Vol. 1. Cambridge University Press, Cambridge, England.
- Van der Plank, J.E. 1963. *Plant Diseases: Epidemics and Control*. Academic Press, New York, NY, and London, England.
- Viennot-Bourgin, G. 1949. *Les champignons parasites des plantes cultivées*. Masson & C^e (Ed.). Paris, France.
- Yarwood, C.E. 1978. History and taxonomy, pp 1–10. In Spencer, D.M. (Ed.). *The Powdery Mildews*. Academic Press, London, England. 565 pp.

¹*Plant Pathology Lab*
 I.M.I.A. (Instituto Madrileño de Investigación Agraria)
 Apdo. 127
 Alcalá de Henares 28800
 Madrid, Spain
 tello@inia.es

²*Cátedra de Patología Vegetal*
 ETSI Agrónomos
 Universidad Politécnica
 Ciudad Universitaria s/n
 Madrid 28040, Spain

*Corresponding author: M. Luisa Tello

Zusammenfassung. Die Platane ist einer der meist verwendeten Baumarten in spanischen Städten. Für schätzungsweise die letzten 30 Jahre wurde die Gesundheit von städtischen Baumplantagen in verschiedenen Teilen der iberischen Halbinsel beobachtet und dabei eine Anzahl von Krankheiten, die die Mehrheit betrafen, entdeckt. Die häufigsten Krankheiten an Platanen sind die Pilze (*Sporonema platani* Blamül – gelegentlicher Überträger von Anthracnose und *Microsphaeraalni* (D.C.) Wint. – Mehltau - , sowie andere untergeordnete Pathogene. Seit 1997 haben wir unsere Forschung auf die Untersuchung der Baumgesundheit in der Stadt Aranjuez (Madrid), einer exemplarischen Stadt in Zentralspanien, ausgerichtet. Innerhalb der zahlreichen Baumarten in der Region wurde bei den Platanen ein ernstes Problem entdeckt. Die beobachteten Symptome (Triebe und Zweige bis zu 3 Jahren wachsen in Quirlen, nekrotisches Gewebe dicht an Phloem und Xylem, vorzeitiger Blattfall) wiesen auf die mögliche Existenz von *Gnomonia veneta* (Sacc et. Speg.) Kleb, anamorph *Sporonema platani* Blamül hin. Die Mehrheit der Bäume zeigten diese Symptome auf die ein oder andere Weise. Durch die Anwendung von Diagnose- und Identifizierungsmethoden im Labor waren wir in der Lage, das Vorkommen von *Sp. platani* in allen Proben von symptomzeigenden Bäumen zu demonstrieren. Es kann daraus geschlossen werden, daß die Anthracnose und der Mehltau zu den ernstzunehmenden Krankheiten an Platanen gehört. In Aranjuez, so glauben wir, ist die Anthracnose unter den Platanen weit verbreitet und da diese Baumart einen Großteil der Bäume in der Stadt ausmacht, ist der pathologische Befund besonders beunruhigend.

Resumé. Le platane (*Platanus* spp.) est un des arbres les plus fréquemment utilisé en ornementation en Espagne. Au cours des 30 dernières années environ, la santé des plantations d'arbres urbains de diverses régions de la péninsule ibérique a été suivie et un certain nombre de maladies, communes à la majorité d'entre eux, détecté. Les maladies les plus fréquentes qui affectent le genre *Platanus* sont le *Sporonema platani* Blaüml, l'agent causal de l'anthracnose, et

le *Microsphaeraalni* (DC.) Wint., celui du blanc des feuilles, tout comme d'autres agents pathogènes mineurs. Depuis 1997, nous avons orienté nos recherches vers la surveillance de la condition de santé des arbres urbains dans la ville de Aranjuez (Madrid), ce comme exemple type d'une zone urbaine du Centre de l'Espagne. Parmi les nombreuses espèces qui existent dans la ville, un problème sérieux a été détecté au niveau des platanes. Les symptômes observés (jeunes pousses et branches jusqu'à 3 ans qui croissent en spirales, nécrose de tissus près du xylème et du phloème, défoliation prématurée) indiquent l'existence possible de *Gnomonia veneta* (Sacc. et. Speg.) Kleb, un anamorphe de *Sporonema platani* Blamül. La majorité des arbres montrent ces symptômes à des degrés divers. En appliquant des méthodes d'identification et diagnostic en laboratoire, nous avons été capables de démontrer la présence de *S. platani* dans tous les échantillons recueillis d'arbres symptomatiques. On peut conclure que les maladies les plus importantes affectant les platanes en Espagne sont l'anthracnose et le blanc des feuilles. À Aranjuez, nous croyons que l'anthracnose est largement répandue chez les platanes, et comme cette espèce constitue la proportion la plus importante d'arbres dans la ville, nous considérons cette situation pathologique comme particulièrement inquiétante.

Resumen. El plátano (*Platanus* spp.) es uno de los árboles más frecuentemente usado como ornamental en las áreas urbanas de España. Por aproximadamente 30 años ha sido observada la salud de las plantaciones urbanas en varias partes de la Península Ibérica y un número de enfermedades ha sido detectado, la mayoría de ellas comunes. Las más frecuentes enfermedades que afectan a *Platanus* spp. son el hongo (*Sporonema platani* Blaüml) –agente causal de antracnosis –y *Microsphaeraalni* (DC.) Wint. –mildeu u oídio-, como también otros patógenos menores. Desde 1997 hemos enfocado nuestra investigación en la evaluación del estado de salud de los árboles urbanos en la población de Aranjuez (Madrid), como un ejemplo de una localidad urbana del centro de España. Dentro de las numerosas especies de árboles que existen allí, se detectó una serie de problemas entre los árboles de plátano. Los síntomas observados (brotes jóvenes y ramas mayores de 3 años creciendo en verticilos, tejido necrosado cerca al floema y xilema, defoliación prematura) indican la posible existencia de *Gnomonia veneta* (Sacc et. Speg.) Kleb y *Sporonema platani* Blaüml. La mayoría de los árboles mostraron estos síntomas en un grado u otro. Aplicando métodos de diagnóstico e identificación en el laboratorio pudimos demostrar la presencia de *S. platani* en todas las muestras tomadas de árboles sintomáticos. Se puede concluir que la mayoría de las enfermedades relevantes que afectan a los árboles de plátano en España son antracnosis y mildew. En Aranjuez, nosotros creemos que la antracnosis está dispersa en los árboles de plátano, y debido a que ellos constituyen una proporción significativa del número total de árboles, consideramos su estado patológico como particularmente preocupante.